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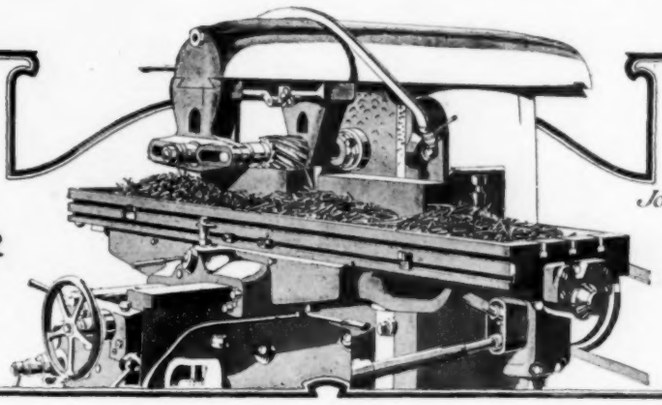
THE NEW CINCINNATI No. 5 HIGH POWER MILLING MACHINE

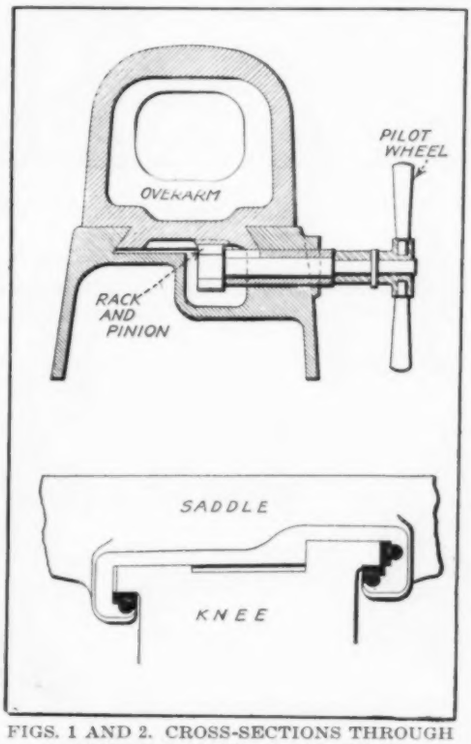


By
John H. Van Deventer
Editor in Chief,
American Machinist

This new product of the Cincinnati Milling Machine Co. marks an advance in the continual struggle for supremacy between the machine tool and the cutting tool. Its massive construction, new features of design, operating conveniences and adequate powering enable this machine, when equipped with modern high-power cutters, to resolve production problems into terms of jigging and chip disposal. Although this article is the first description of this milling machine, it has been subjected to a very thorough test, and some three hundred machines of this type and size have been distributed during the last two years.

IT MAY not be amiss to apply a very apt comparison to introduce the machine described in this article, and so I will briefly sketch the historic struggle between artillery and infantry. When cannon was first invented, infantry (if we can call it such) literally took to the woods. But before long came the "fire arms" which enabled the infantrymen to pick off the early cannoneers because these shoulder arms, although crude, had better range. Later on, in Napoleon's time, cannon was so improved that artillery gained the ascendancy, and nearly won him the world. Then came the breech-loading rifle which once again turned the tables; while the present war with its wonderful development of long-range guns put artillery once more in the van.

Now this same game of see-saw has been going on for years between the machine tool and the cutting tool. One would have said eight years ago in reading the article entitled "Milling Cutters, Their Efficiency," in the *American Machinist*, that a milling cutter had at last scored a final decision. A glimpse of this new "number five" at work assures one, however, that the miller can now claim a draw with the cutter. This fact causes two different factors to limit production; namely, jigging and chip disposal. In other words, the cutting time on the average job has now been reduced to a point that makes the ability of the operator to load and unload his fixture the limiting factor.



FIGS. 1 AND 2. CROSS-SECTIONS THROUGH OVERARM, KNEE AND SADDLE

The logical way to describe a machine is to first tell how it is constructed and then what it will do; but in this case I think it will be more interesting to tell some of the things that this machine does and then show how it was built to do them. Performance tests which extend only over a short period of time, and which are beyond the limits of application to practical use, are of course of little practical value. Tests, such as the following, however, are both useful and convincing in demonstrating the rigidity, driving power and strength of a machine tool.

With braces on the overarm and using a 4½-in. diameter spiral mill of 6-in. face, having 10 teeth with 15-deg. undercut, the cutter running at 60 r.p.m., the following roughing cuts were taken over a block of machinery steel 5 in. wide and approximately 24 in. long, having a tensile strength of between 55,000 and 65,000 lb. The cutter ran at a speed of 60 r.p.m., which represents a surface speed of approximately 70 ft. per minute. The following table shows the feeds and speeds that were obtained under these conditions:

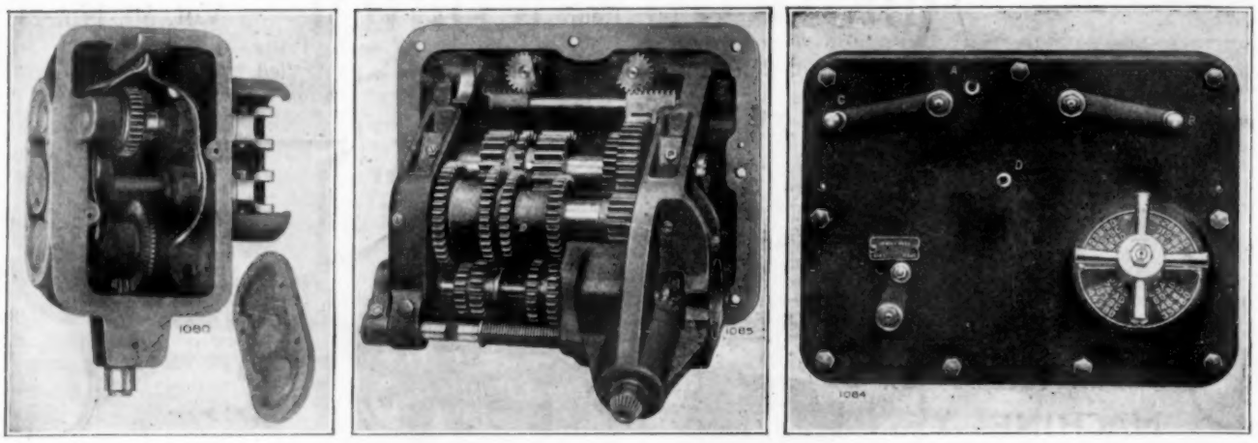


FIG. 5. SPEED CHANGER FOR FEED DRIVE. FIGS. 6a AND b. FRONT AND REVERSE SIDES OF SPINDLE SPEED CHANGE UNIT

Depth of Cut, Inches	Width of Cut, Inches	Feed, Inches per Min.	Cu.In. of Metal Removed per Min.
¼	5	30	18.75
¼	5	30	37.5
⅜	5	30	56.25
½	5	11½	29.375
½	5	19	47.5

Neither distress nor excessive vibration was noticeable at any of these cuts, although the last one required a net horsepower input of 80 hp., or four times the normal maximum powering of this machine. A cut ½ in. deep was taken on the same steel block at a cutting speed of 340 ft. per min., with feeds first at 19 in. per min. and then at 30 in. per min.; a straight-edge applied to the surface after this cut held tissue paper at four points. For the ordinary run of work and with the average size of milling cutter close to the column, overarm braces are not required. A roughing cut without braces on the same block and with the same cutter was taken at ¼ in. depth and 30 in. per min. feed, followed by a finishing cut at 30 in. per min. The resulting surface was as accurate and smooth as would be required in first-class commercial work.

Perhaps the most interesting test performed on this machine was that of milling, simultaneously, two slots 1½ in. wide and 1½ in. deep in one cut from the solid in the same grade of machinery steel. Two cutters were mounted on the arbor, each cutter, 1½-in. face by 8-in. diameter, having 18 teeth staggered right and left, each tooth taking ¾ of the full width of cut. The feed on this cut was 9¼ in. per min. These remarkable performances are made possible by general massiveness of construction combined with two principal features of design: namely, an overarm of rectangular cross-section with V-shaped guides, and square gibbing and narrow guides for the column, knee and saddle bearings. Both of these features may be observed in the illustration forming the title-piece of this article.

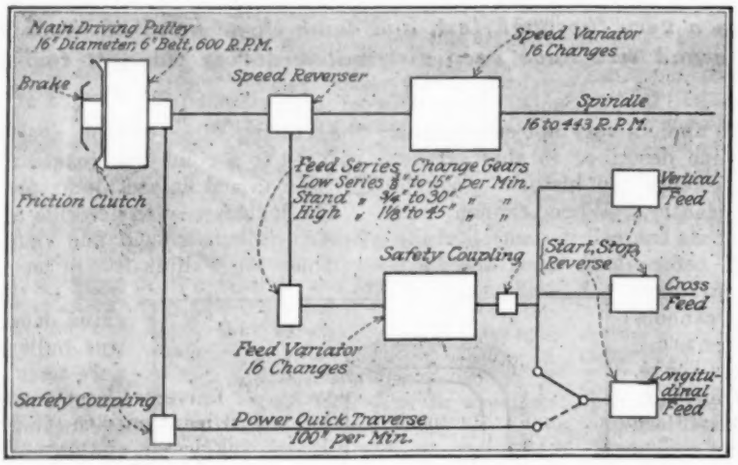
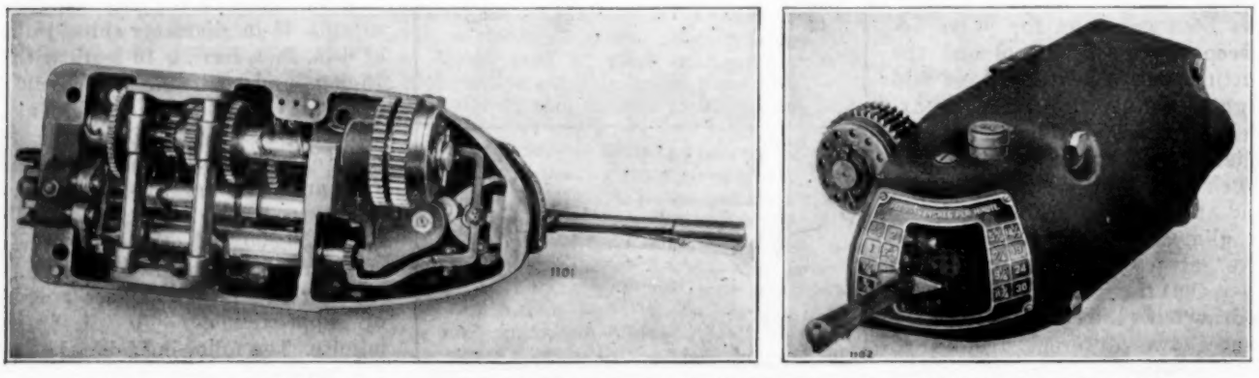


FIG. 8. DIAGRAMMATIC REPRESENTATION OF DRIVING MECHANISM



FIGS. 7a AND b. FRONT AND REVERSE SIDES OF FEED CHANGE UNIT CONTROLLING LONGITUDINAL TRAVERSE AND VERTICAL FEEDS

A cross-section through the overarm showing the V-guides and also the rack-and-pinion mechanism for moving the overarm lengthwise is presented in Fig. 1. This adjustment feature is an operating convenience which enables one not only to move the overarm easily but also to set it readily to a line by means of a pilot wheel. The knee bearing on the column and the saddle bearing on the knee have heavy square guides which are provided with thick taper gibs that are adjusted lengthwise, as shown in Fig. 2. The combination of the square guides on the column and V-guides on the overarm form a particularly rigid and ready means of attaching the various complementary mechanisms for vertical milling, rack cutting, slotting, etc. The offset knee-guide construction, shown in Fig. 2, permits the builders to make this miller in the universal type without raising the table surface more than 1½ in. over the standard table of the plain machine.

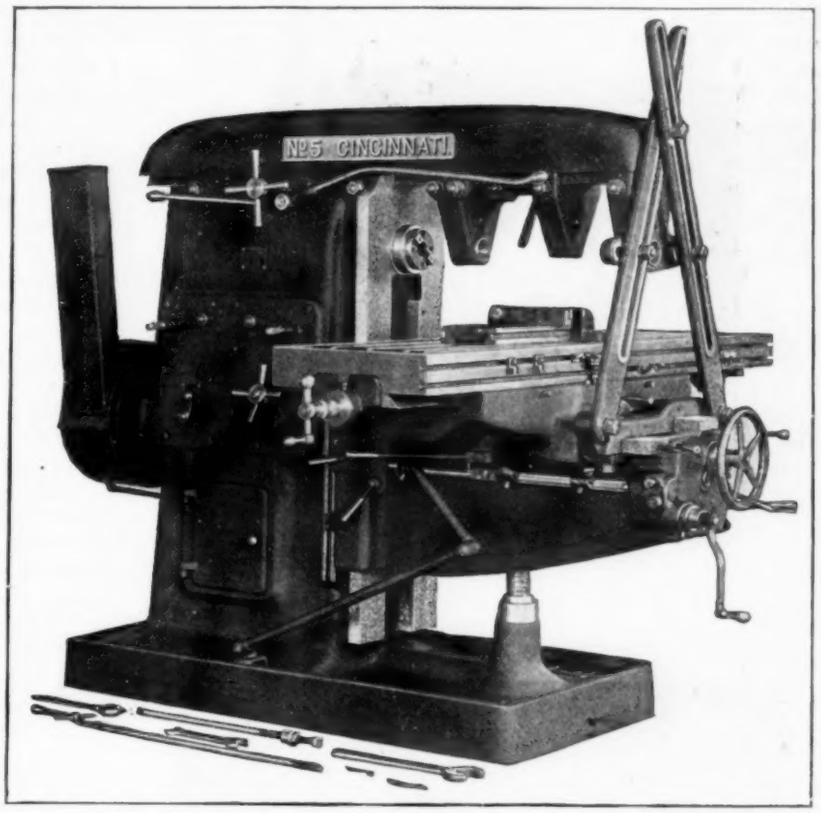


FIG. 4. THE NEW NO. 5 PLAIN MACHINE. NOTICE THE WIDE SADDLE BEARINGS, LARGE BASE, PILOT WHEEL FOR MOVING OVERARM, DUPLEX CONTROL, AND BELT GUARDS

A diagrammatic representation of the drive mechanism is shown in Fig. 3. The driving pulley, built as a unit with the oil pump, friction clutch and brake, follows the lines of automobile construction by being "full floating." In other words, it is mounted on ball bearings on an independent bracket which relieves the main shaft from belt pull. The powerful friction clutch starts and stops the machine and the brake is automatically brought into action by the starting and stopping lever so that the spindle comes to an immediate stop. All of the gears and shafts used in transmitting power and feeds are hardened steel. All of the speed changes are accomplished by means of selective sliding gears, eliminating tumblers. A spindle-reversing mechanism provides for running the spindle either right or left handed.

The speed changes, which vary from 16 to 443 r.p.m., are made by means of the drive box shown in Fig. 5. Sixteen speed changes are obtained by means of the four positions of the pilot wheel in combination with the two positions of each of the large swinging levers. The spindle reverse is controlled by the small swinging lever shown in the same illustration.

The feed-changing mechanism is of particular interest. Before mentioning this, however, it is well to call attention to the feed bracket on the column shown in Fig. 6. This connects the drive with the feed-change mechanism and the power quick traverse. The normal range of feeds on this machine is from ¾ in. to 30 in. per min. Occasionally a slower feed than ¾ in. is required and also a faster feed than 30 in., and to provide for such contingencies the ratio between the feed drive and speed drive may be changed by substituting other gears at *A* and *B*. In this way a slow series of feeds of from ¾ in. to 15 in. per min. or a fast series of from 1½ to 45 in. per min. may be obtained through change gears. A universal-joint shaft leads from the feed bracket just mentioned to the feed box proper, shown in Fig. 7. The design of this feed box is of particular interest. It contains the complete mechanism for the sixteen feed changes which are made by a single lever through sliding gears. The feed changes are made while the machine is running, the operator moving a lever up and down or from side to side or diagonally, going direct from one feed to any other. This is accomplished by means of the mechanism shown inside the box which discloses two rotating camshafts. The lower shaft is actuated by the horizontal movement of the hand-control lever, the upper shaft by its vertical movement. The combination of the movements of these two camshafts, caused by any movement of the single hand-control lever, causes a corresponding movement of the selective sliding gears and results in obtaining a given feed ratio.

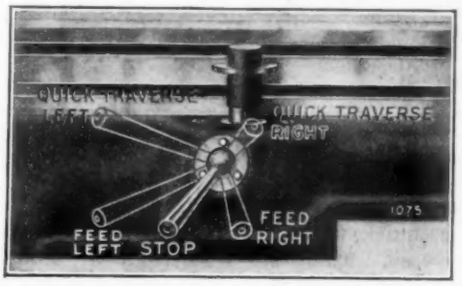


FIG. 8. FEED-CONTROL LEVER. ITS FOUR POSITIONS SHOWN IN OUTLINE CONTROL ALL TABLE MOVEMENTS

The spur gear that is seen protruding from the case in Fig. 7 transmits the feed power from the feed-change

mechanism to the feed reversers and feed screws. A safety device is incorporated at this point. It consists of a number of steel balls held in spherical recesses by spring pressure and which slip at a predetermined load. They may be seen around the circumference of the flange of the protruding gear in Fig. 7.

A quick traverse of 100 in. per min. is provided for longitudinal movement of the table in both directions. For vertical movement of the knee and cross-movement of the saddle the maximum feed of the feed box (usually 30 in. per min.) is used as quick traverse, 100 in. per min. being too rapid for these shorter movements.

It is evident that a machine which reaches the limit in fast cutting puts the production rate up to the ability of the operator to load and unload his table. Realizing the importance of relieving the operator manually as much as possible on quantity-production work, the designers of the Cincinnati No. 5 have worked out an ingenious system of table dogging which, when applied by the user, practically converts the machine into an automatic miller. This arrangement is extremely simple and is an extension of the application of the usual dogs which are found on every miller for the purpose of limiting the table travel. The feed-control mechanism shown in Fig. 8 has been arranged so that table dogs, in addition to merely throwing out the feed, will, when required, reverse the table movement, throw from quick traverse to feed in either direction and vice versa. There is no more "red tape" in the set-up for this automatic control of the table than there is in setting a pair of planer dogs. A surprising number of combinations or cycles are possible when these dogs are used, this being indicated in Fig. 15.

One of the most convenient operating features of this new machine is the duplex control. Starting and stopping action, feeds in all three directions and quick traverse are controllable from the rear as well as from the front of the table. This is of particular importance on the universal machine. This machine is absolutely similar in design to the plain machine except for the addition of the universal feature which provides the swiveling of the table 50 deg. to either side of its normal position. The universal machine, which is illustrated in Fig. 9, is provided with a power quick traverse but not with intermittent feed. The power quick traverse on this machine is hand-operated and is designed so that the operator has to hold the lever in position in using the quick movement. When he lets it go the quick traverse is automatically disengaged and the table comes to a stop.

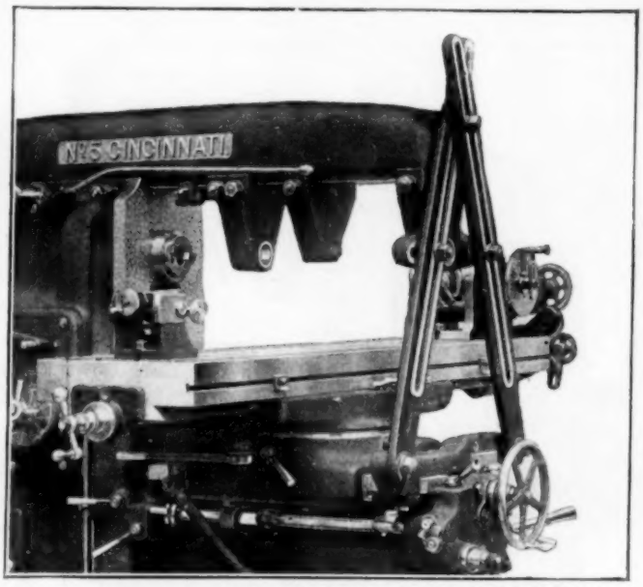


FIG. 9. THE CINCINNATI NO. 5 HIGH-POWER UNIVERSAL. THE OFFSET KNEE-GUIDE CONSTRUCTION PERMITS OF COMPACT AND RIGID DESIGN

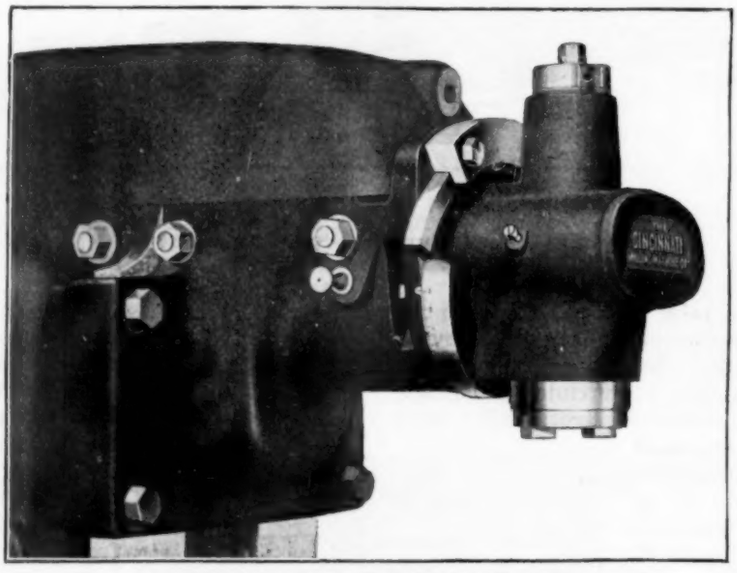


FIG. 10. THE COMPLEMENT WHICH CONVERTS THIS MACHINE INTO A VERTICAL MILLER

The table width on the universal is 20 in., and on the plain machine is 21 in. Both of these wide tables give ample opportunity for the convenient attachment of jigs and facilitate the work of clamping.

The spindle bearings, the spindle drive gears and shafts, and all other rotating parts in the column are lubricated by a positive pump delivering oil into a reservoir at the top of the machine, from which independent pipes lead to individual bearings. There are, in addition to this automatic lubrication, six oiling stations which take care of all remaining bearings in the saddle, the knee, feed box and table.

Coolant is circulated by means of a centrifugal pump connected with a reservoir in the base of the machine. The table design incorporates screened openings which return the lubricant rapidly to the reservoir.

The word "attachment" to my mind indicates a sort of mechanical "afterthought." When a machine "attachment" is properly designed it is in reality not an "attachment" but a *complement*, which in use becomes an integral part of the machine and completes it for a given purpose. The complementary mechanisms designed for this No. 5 high-power machine convert the machine into a vertical miller, a rack miller, slotter, spiral miller and a circular miller. They are shown in Figs. 10 to 14, inclusive. As an indication of the rigidity and power of these complementary mechanisms I might mention a performance of the machine con-

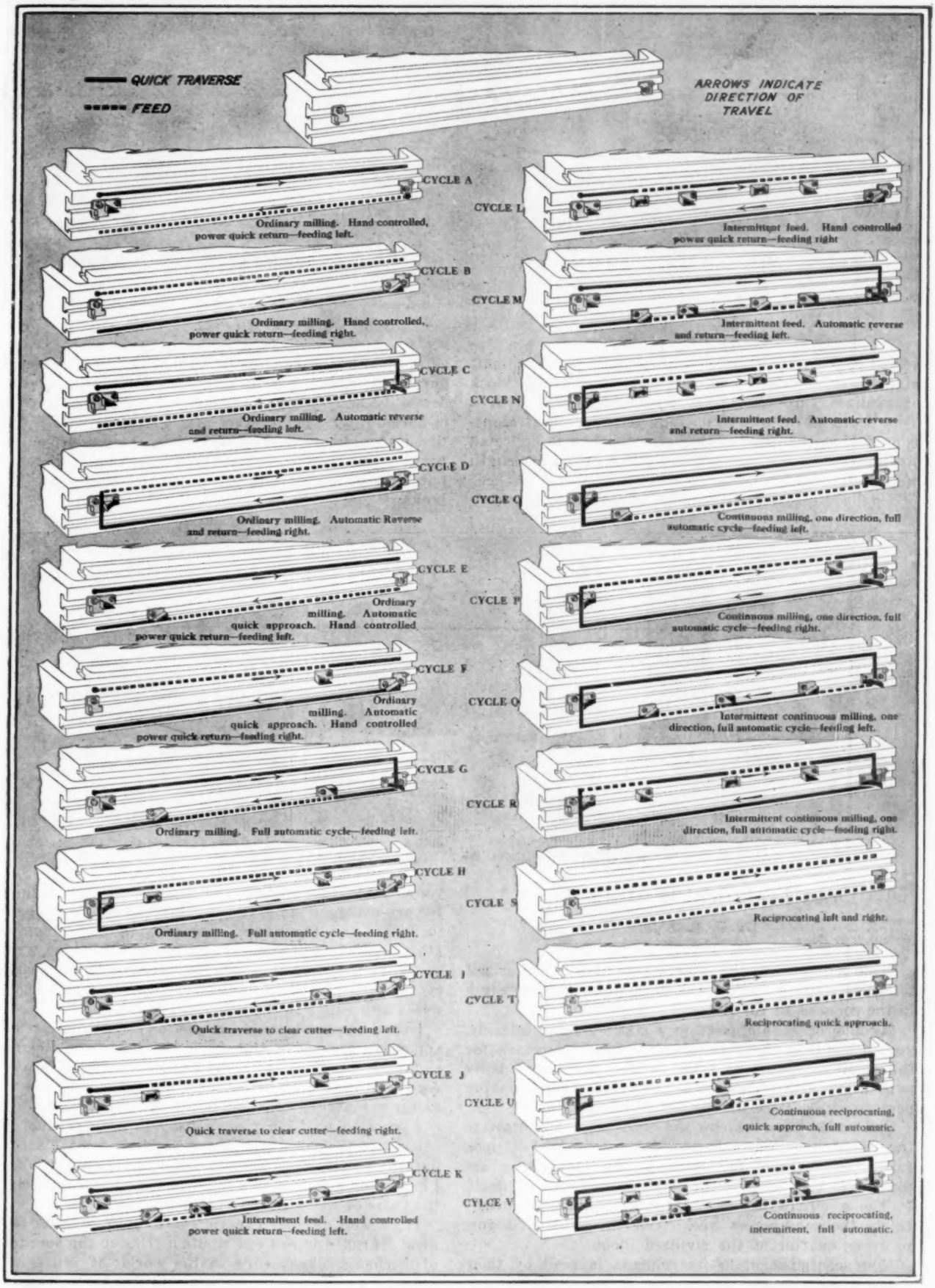

QUICK TRAVERSE
FEED
ARROWS INDICATE DIRECTION OF TRAVEL
CYCLE A
Ordinary milling. Hand controlled, power quick return—feeding left.
CYCLE B
Ordinary milling. Hand controlled, power quick return—feeding right.
CYCLE C
Ordinary milling. Automatic reverse and return—feeding left.
CYCLE D
Ordinary milling. Automatic Reverse and return—feeding right.
CYCLE E
Ordinary milling. Automatic quick approach. Hand controlled power quick return—feeding left.
CYCLE F
Ordinary milling. Automatic quick approach. Hand controlled power quick return—feeding right.
CYCLE G
Ordinary milling. Full automatic cycle—feeding left.
CYCLE H
Ordinary milling. Full automatic cycle—feeding right.
CYCLE I
Quick traverse to clear cutter—feeding left.
CYCLE J
Quick traverse to clear cutter—feeding right.
CYCLE K
Intermittent feed. Hand controlled power quick return—feeding left.
CYCLE L
Intermittent feed. Hand controlled power quick return—feeding right
CYCLE M
Intermittent feed. Automatic reverse and return—feeding left.
CYCLE N
Intermittent feed. Automatic reverse and return—feeding right.
CYCLE O
Continuous milling, one direction, full automatic cycle—feeding left.
CYCLE P
Continuous milling, one direction, full automatic cycle—feeding right.
CYCLE Q
Intermittent continuous milling, one direction, full automatic cycle—feeding left.
CYCLE R
Intermittent continuous milling, one direction, full automatic cycle—feeding right.
CYCLE S
Reciprocating left and right.
CYCLE T
Reciprocating quick approach.
CYCLE U
Continuous reciprocating, quick approach, full automatic.
CYLCE V
Continuous reciprocating, intermittent, full automatic.

FIG. 15. DIAGRAMS ILLUSTRATING THE APPLICATION OF THE INTERMITTENT-FEED FEATURE AND SHOWING TABLE DOGGING FOR VARIOUS CLASSES OF WORK

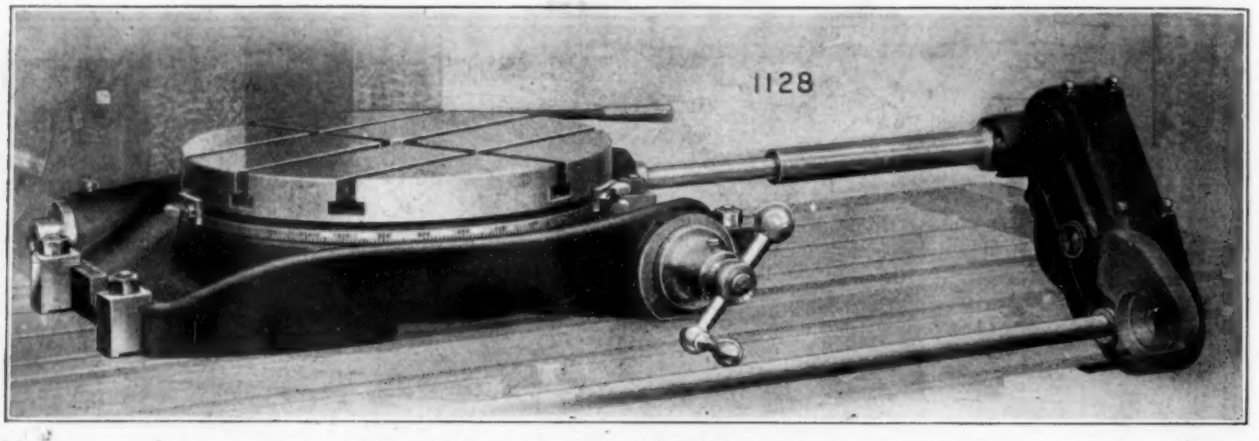
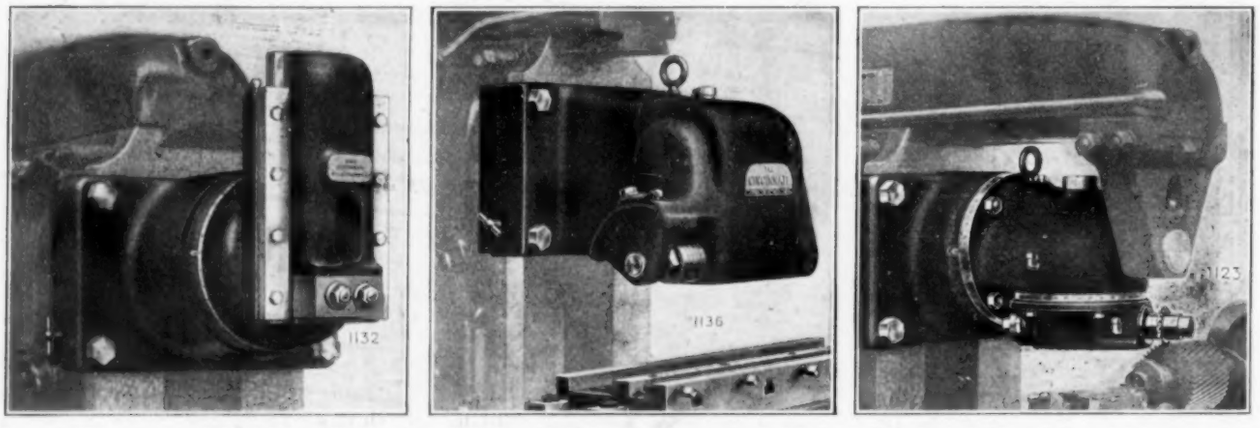


FIG. 11. THE CINCINNATI NO. 5 EQUIPPED FOR CIRCULAR MILLING

verted into a vertical miller. Using a 12-in. Cincinnati high-power inserted-tooth face-mill, a cast-iron block of medium hardness 12 in. wide was milled with a ¼-in. depth of cut at 11¾ in. feed per min. A straightedge test at the close of this accomplishment indicated straightness of surface within 0.001 on a 24 in. length and 12 in. width.

Usually a machine tool can be easily classified either as a quantity-production machine or as a general-purpose machine. With its brute strength, rigidity, flexibility and range of complementary mechanisms, it is hard to say whether this new Cincinnati No. 5 will find its maximum field of service in the production department or the toolroom. There is no doubt, however, but that it is destined to render valuable service to both.



FIGS. 12, 13 AND 14. COMPLEMENTARY MECHANISMS FOR SLOTTING, RACK CUTTING AND SPIRAL MILLING

Does Technical Writing Pay?

BY G. R. SMITH
Pittsfield, Mass.

Some months ago the question as to whether or not technical writing "paid" was discussed at some length in the columns of the *American Machinist*.

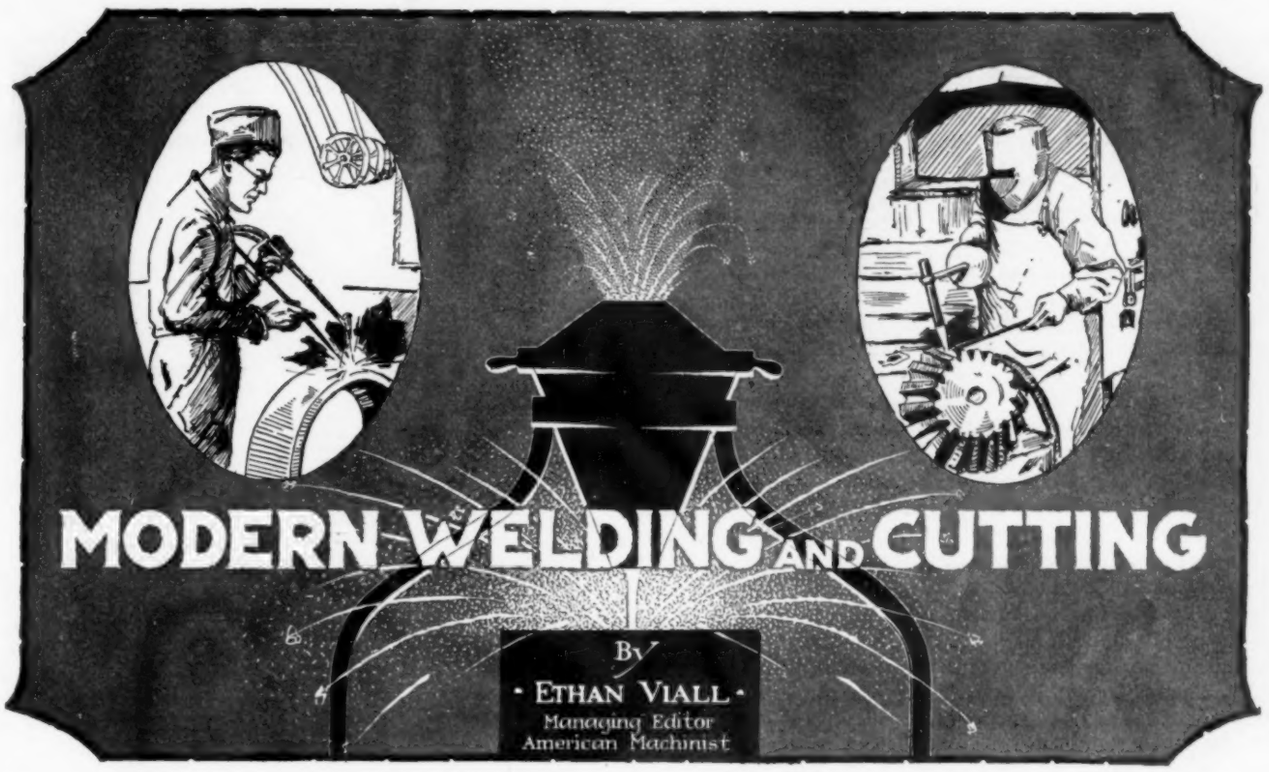
My answer to this question would be, unhesitatingly, yes; not only is there an adequate financial return for the small allotment of time devoted to it, but there is infinitely greater reward in the satisfaction of having performed a service for the benefit of mankind.

One never knows where the seed sown broadcast in the columns of the technical journal is to fall upon fallow soil. Take, for instance, the journal we are pleased to call "ours"—the *American Machinist* itself. It has a circulation in this country alone of nearly thirty thousand copies weekly, and in addition it goes to every quarter of the civilized globe.

Your contribution to its columns is read by thousands of your fellow countrymen in the United States, and also by engineers and mechanics in all parts of Europe, Africa and Asia. It is quite possible that while your words are holding the interest of the English factory-manager in his London club, the native mechanic in India, and the mining engineer in the Transvaal (this depends somewhat on how interestingly you write, you know), the same words are perhaps being puzzled out by a machine-shop foreman in Greenland or a husky, dusky apprentice in the Solomon Islands.

I have personally received queries concerning articles appearing under my signature, not only from Belgium and other countries in nearby Europe, but from faraway Australia, and even from the Falkland Islands on the extreme southern coast of South America. I have on one occasion paid out more money in postage than the amount of the check received in payment for the article, but the satisfaction derived from the knowledge that I have been able to help a fellow-mechanic far outweighs the value of any monetary consideration.

If by writing your experiences to your favorite technical journal you can contribute a trifle to the sum total of mechanical knowledge in the world; if you can do something that is going to help your brother on the next bench, in the shop on the next street, or on the other side of the world your work is justified.



XII. Gas Torches Used For Welding

To the welder it is important that he should know the construction of his torch as well as its use. This article describes the common makes and illustrates them in detail. Several tables of valuable data are also given for the use of the practical man.

THE gas torches used for welding in the United States may be divided into two general types, known as medium-pressure and low-pressure torches. Each type is made in a number of sizes, and each size is usually provided with a number of interchangeable tips for producing flames of different size.

The medium pressure torches are also known as positive-pressure torches, and to avoid misunderstanding, they will be referred to as positive-pressure torches hereafter. In these torches, using acetylene and oxygen for welding, the acetylene pressure will range from 1 to 14 lb. and the oxygen pressure from 1 to 24 lb. per square inch, the pressure employed depending on the thickness of the metal being welded, the make of torch, and the tips used. The pressures given may even be exceeded in some exceptional cases.

A sectional view of a typical positive-pressure welding head is shown in Fig. 108. The oxygen enters at *A* and the acetylene enters at *B*. The oxygen goes to the small chamber *C* and thence out through the center hole. The acetylene goes to the chamber *D* and also out through the center hole, the two gases starting to mix at the point *E*, and as they pass out through the channel *F* to the end of the tip, they are thoroughly mixed. In this illustration, the removable tip is indicated by *G*. This make of tip has a conical seat and is held in place by means of the lock collar *H*. Made in this way, there are no threads on the tip itself, although the practice varies in different makes.

The low-presure torch is also known as the injector type. In this type of torch, the acetylene, or other gas, is supplied under a pressure of a few ounces up to 1 lb., but the oxygen may have a pressure of from 5 to 30 lb. per square inch, according to the size of tip being used. In some cases the oxygen pressure may be either higher or lower than the figures given. A sectional view of a typical low-pressure torch is shown in Fig. 109. In this torch the acetylene, or other gas, enters at *A* and the oxygen at *B*. The acetylene goes to the chamber *C* from which it is sucked by the oxygen pouring out through the nozzle at *D*, and it is carried along with the oxygen into the mixing chamber

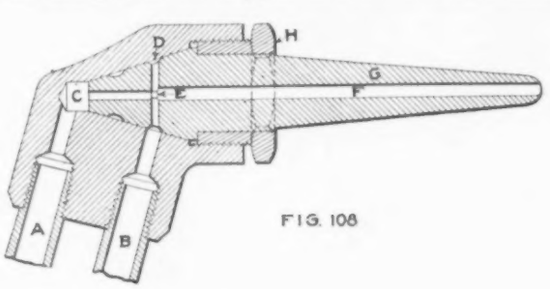


FIG. 108

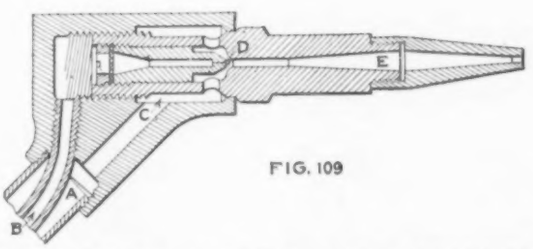


FIG. 109

FIGS. 108 AND 109. A TYPICAL POSITIVE-PRESSURE WELDING TORCH AND A LOW-PRESSURE OR INJECTOR TYPE OF WELDING TORCH

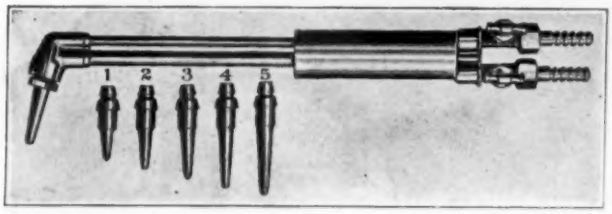


FIG. 110. THE DAVIS-BOURNONVILLE STYLE C POSITIVE-PRESSURE WELDING TORCH

E in the tip of the torch. From this chamber the gases issue thoroughly mixed and ready for combustion.

As they qualify for classification as either positive-pressure or low-pressure types of torches, the various makes of each type differ principally in form, the general principles of action remaining the same. A few examples of the different makes of positive-pressure torches will be shown first, and these will be followed by others of the low-pressure or injector type.

A standard form of a positive-pressure welding torch, made by the Davis-Bournonville Co., is shown in Fig. 110 and in detail in Fig. 111. A number of torches used for various purposes are shown in Fig. 112. In this illustration, *A* is a small lead-burning torch. *B* is a midget torch used for welding very light sheet metal for manufacturing purposes, such as the seams of cook-

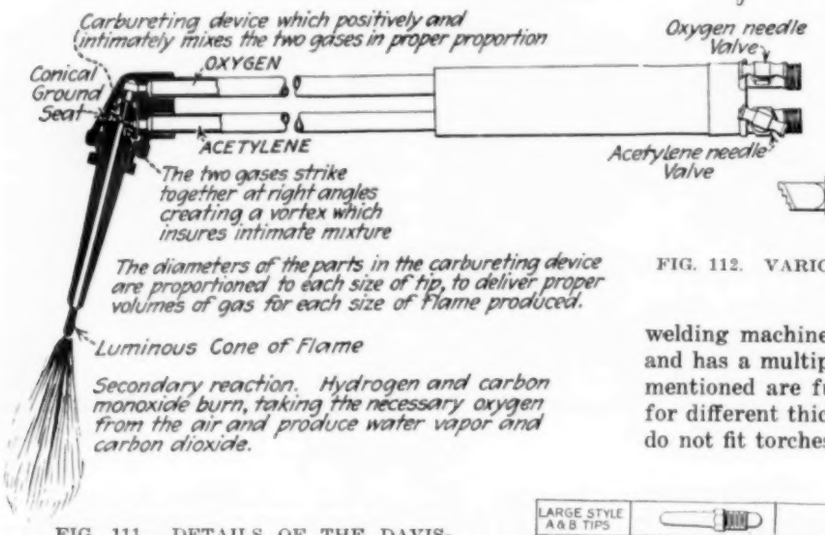

Carbureting device which positively and intimately mixes the two gases in proper proportion
OXYGEN
Conical Ground Seat
ACETYLENE
The two gases strike together at right angles creating a vortex which insures intimate mixture
Oxygen needle Valve
Acetylene needle Valve
The diameters of the parts in the carbureting device are proportioned to each size of tip, to deliver proper volumes of gas for each size of flame produced.
Luminous Cone of Flame
Secondary reaction. Hydrogen and carbon monoxide burn, taking the necessary oxygen from the air and produce water vapor and carbon dioxide.

FIG. 111. DETAILS OF THE DAVIS-BOURNONVILLE WELDING TORCH

ing utensils, aluminum ware, etc. It weighs about 8 oz., is 10 in. long, and may be used on sheets up to $\frac{1}{8}$ in. thick. *C* is a small-size torch for metal from $\frac{1}{32}$ to $\frac{5}{16}$ in. thick, weighs 18 oz., is 14 in. long and uses oxygen pressures, with different tips, of from 2 to 10 lb. *D* is a manufacturer's torch, intended for use on boilers, steel barrels, metallic caskets, tanks, cylinders, etc. The head is set at right angles to the body, which has been found best for this work. It weighs 24 oz., is 18 in. long and uses oxygen at 2 to 10 lb. pressure, according to the tips employed. *E* is a large torch for heavy welding. It weighs 2 lb., is 20 in. long, and uses oxygen at 12 to 20 lb. pressure. It is used on metal from $\frac{1}{4}$ in. thick up. *F* is a water-cooled torch, used for heavy welding where the tips have a tendency to become overheated. It is 36 in. long and weighs about $3\frac{1}{2}$ lb. Four lines of hose are needed with it, two for water and two for gas. *G* is used for welding with oxygen and hydrogen. *H* is for use on a welding machine. *I* is a water-cooled torch for a

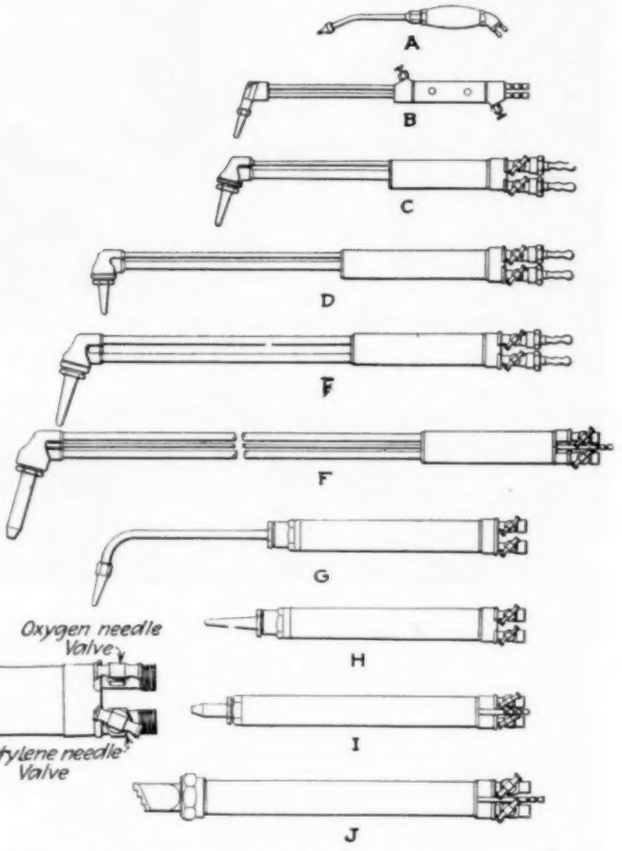


FIG. 112. VARIOUS MODELS OF DAVIS-BOURNONVILLE WELDING TORCHES

welding machine. *J* is water-cooled, for machine use, and has a multiple-jet nozzle or tip. All of the torches mentioned are furnished with five interchangeable tips for different thicknesses of metal. These tips, however, do not fit torches of different size; that is, the tips for

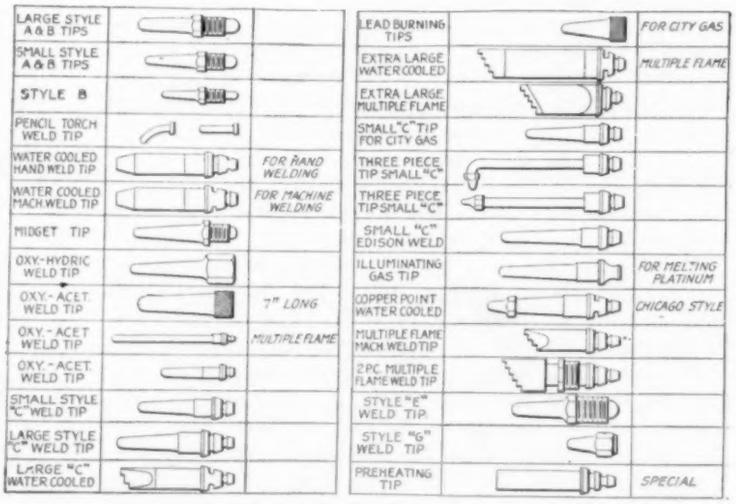


FIG. 113. DIFFERENT KINDS OF TIPS USED WITH DAVIS-BOURNONVILLE WELDING TORCHES

large torches will not fit small ones, nor vice versa. All the torches named are intended for oxygen and acetylene, except where mentioned otherwise. A number of different tips designed to be used with the torches illustrated, are shown in Fig. 113.

The approximate pressures of oxygen and acetylene as used in the Davis torches, are given in Table IX. The tips referred to in compiling this table, are known as styles Nos. 99 and 100, and are used with style *C* torches. These pressures serve only as approximate guides and are not to be taken literally in practice.

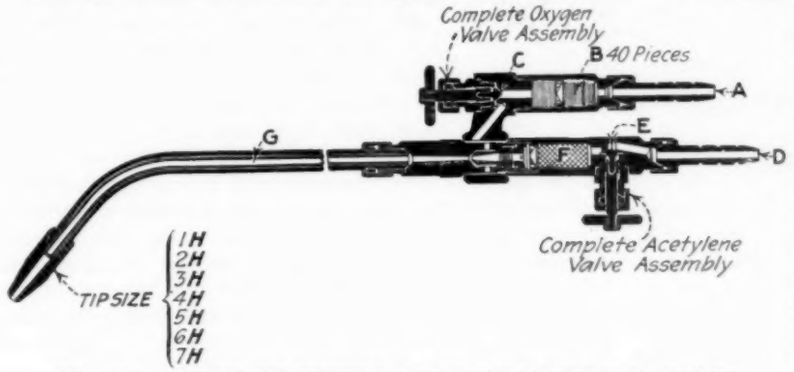


FIG. 114. DETAIL OF PREST-O-LITE TYPE H WELDING TORCH

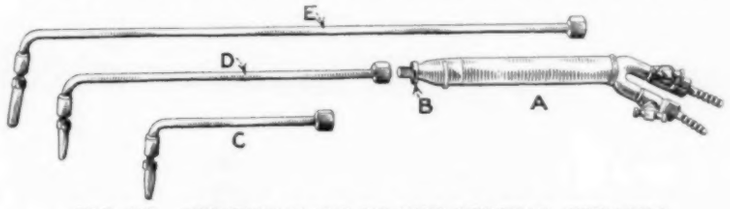


FIG. 115. TORCHES MADE BY THE GENERAL WELDING AND EQUIPMENT CO.

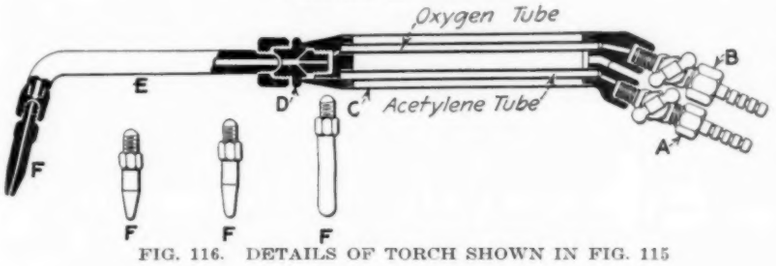


FIG. 116. DETAILS OF TORCH SHOWN IN FIG. 115

TABLE IX. APPROXIMATE GAS PRESSURES FOR DAVIS-BOURNONVILLE STYLE C WELDING TORCH, WITH NOS. 99 AND 100 TIPS

Tip No.	Thickness of Metal Inches	Acetylene Pressure Lbs.	Oxygen Pressure Lbs.
00	Very	1	1
0	Light	1	2
1	1/32–1/16	1	2
2	1/16–3/32	2	4
3	3/32–1/8	3	6
4	1/8–3/16	4	8
5	1/4–5/16	5	10
6	5/16–3/8	6	12
7	7/16–1/2	6	14
8	1/2–5/8	6	16
9	5/8–3/4	6	18
10	3/4–Up	6	20
11	Extra	8	22
12	Heavy	8	24

The torch shown in detail in Fig. 114 is made by the Prest-O-Lite Co., Indianapolis, Ind., but is handled by the Oxweld Acetylene Co. This torch is fitted with a long stem through which the gases pass and are thoroughly mixed before issuing from the nozzle.

The stem is fitted to the mixing chamber by means of a union nut, which permits the operator to point the welding tip in any direction, without changing his method of holding the torch. This is particularly advantageous for vertical and overhead welding. Both oxygen and acetylene inlets on the torch are fitted with fine-adjustment control valves. The one on the oxygen supply is so placed that the operator while working can make any slight necessary adjustment with the forefinger of the hand that grips the torch. The handle of the torch is fitted with anti-fireback chambers for both gases, filled with a special material through which it is impossible for a flame to pass.

The torch is easy to dismantle, as all parts are screwed together on metal-to-metal seats and no packing or solder is used at any joint.

For extra heavy work, a special stem 22 in. long is furnished, and for close work a 5½-in. stem may be had in addition to the regular size. The regular stem has seven tips, the largest four being of copper which will stand up against the intense heat radiated from the work better than any other metal. The smaller tips are of a special alloy. A similar torch is also made for very light work which weighs only 3 oz. complete.

In the detailed view given of the torch, *A* is the hose nipple through which the oxygen passes. At *B* is a set of 40 strainer cloths for the oxygen filter chamber; *C* is the oxygen needle valve; *D* is the acetylene hose nipple; *E* is the acetylene needle valve; *F* is the acetylene filter-chamber cartridge; *G* is the stem. The seven tips are indicated from 1*H* to 7*H*, and their openings can be determined from Table X.

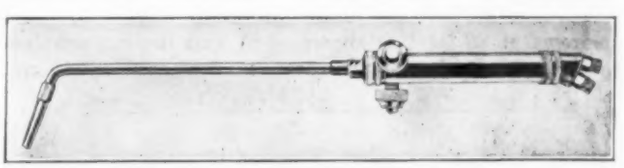


FIG. 117. THE IMPERIAL TYPE B WELDING TORCH

This table is especially valuable in that the nozzle openings are shown in regular twist-drill sizes, furnishing an easy method of comparison. The two tips given at the bottom of the table are extras, used for heavy work. The figures quoted in the table are based on straight

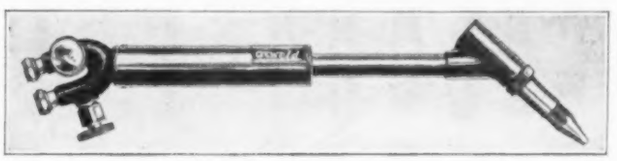


FIG. 118. THE OXWELD LOW-PRESSURE WELDING TORCH

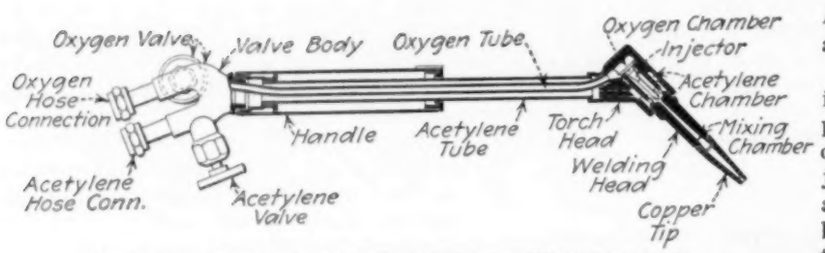


FIG. 119. DETAILS OF THE OXWELD WELDING TORCH

work on steel plate, beveled when over $\frac{1}{8}$ in. in thickness and welded without preheating.

A welding torch made by the General Welding and Equipment Co., Boston, Mass., is shown in Fig. 115. Each torch is furnished with nine tips, affording a range equal to all ordinary welding jobs. In addition, stems of different lengths may be had. In the illustration, *A* is the body of the torch; *B* is the mixing chamber; *C* is a short stem, the use of which makes the entire torch 16 in. long; *D* is a medium stem, making the torch 22 in. long; *E* is a long stem, making the total length of the torch 30 in.

TABLE X. APPROXIMATE WELDING RESULTS WITH TYPE H, PREST-O-LITE TORCH

Tip No.	Tip Drill Size	Gas consumption Cu. Ft. per hour		Thickness of Metal	Blow-pipe pressures Lbs. per sq. in.		Lineal feet welded per hour
		Oxygen	Acetylene		Oxygen	Acetylene	
1H	69	3 to 4	3 to 4	$\frac{1}{32}$ to $\frac{3}{64}$ in.	2 to 3	2 to 3	30 to 35
2H	60	6 to 8½	6 to 8	$\frac{1}{16}$ to $\frac{3}{32}$ in.	2 to 3	2 to 3	24 to 32
3H	55	10 to 12½	10 to 12	$\frac{1}{8}$ to $\frac{5}{32}$ in	3 to 4	3 to 4	12 to 16
4H	52	12 to 21	12 to 20	$\frac{3}{16}$ to $\frac{7}{32}$ in.	4 to 6	4 to 5	9 to 12
5H	49	18 to 28	18 to 26	$\frac{1}{4}$ to $\frac{5}{16}$ in	5 to 7	5 to 6	6 to 8
6H	44	24 to 40	24 to 38	$\frac{3}{8}$ to $\frac{7}{16}$ in.	8 to 11	8 to 9	4½ to 6
7H	35	35 to 54	35 to 50	$\frac{1}{2}$ in. and up	10 to 15	10 to 14	2 to 3
*7J	35	35 to 54	35 to 50	$\frac{1}{2}$ in. and up	9 to 13	9 to 12	Not used on plates
*8J	31	40 to 60	40 to 55	$\frac{1}{2}$ in. and up	9 to 14	9 to 13	Not used on plates

Details of this torch are shown in Fig. 116. Here the acetylene inlet is shown at *A* and the oxygen inlet at *B*. The body of the torch is indicated by *C*, and *D* is the mixing chamber; *E* is the stem, and *F* various shapes of tips.

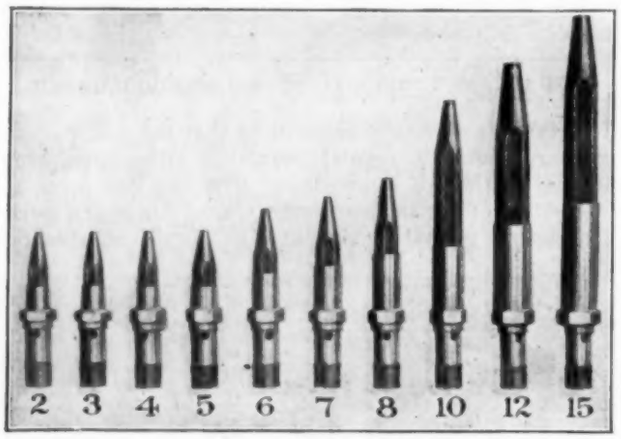


FIG. 120. A SET OF OXWELD WELDING TIPS

Another long-stemmed torch is shown in Fig. 117. This is made by the Imperial Brass Manufacturing Co., Chicago, and differs but little from the one just shown. The gas valves, however, are placed at the forward end of the body. Like most of the other torches, these may be used not only for oxy-acetylene, but also for oxy-hydrogen welding work, special tips and regulators being made for the purpose. For oxy-acetylene, the gas pressures are approximately the same as for other makes of torches. For oxy-hydrogen, the pressures used for various thicknesses of metal and different tips are given in Table XI. However, neither the size of the nozzle holes nor the amount of gas used per hour are given. This firm also makes a three-way torch which in outward appearance does not differ from the one shown. It is intended to use a combination of acetylene, oxygen and hydrogen. The method used is to couple the acetylene and hydrogen hose by means of a Y mixing valve from which the two gases are conducted by a single hose to the torch, the oxygen hose being coupled in the usual way. This concern does not recommend the welding of steel above $\frac{1}{4}$ in., or cast iron above $\frac{3}{4}$ in. in thickness with oxy-hydrogen. For light sheet steel, and especially aluminum, oxy-hydrogen has some advantages, provided the hydrogen can be obtained at reasonable rates. The combination of oxygen-acetylene-hydrogen, however, has a claimed temperature of about 5000 deg. F., which is about half-way between that of oxy-hydrogen and oxy-acetylene. It is also claimed that this flame possesses all the advantages of both the double combinations. The same tips are used as for oxy-acetylene, and only a small percentage of acetylene is needed to give a cone-shaped flame of far greater visibility than that of the oxy-hydrogen flame. The low visibility and long flame of the oxy-hydrogen flame are always a handicap in welding to any operator used to employing the oxy-acetylene torch. The approximate pressures employed when using the Imperial three-way outfit are shown in Table XII.

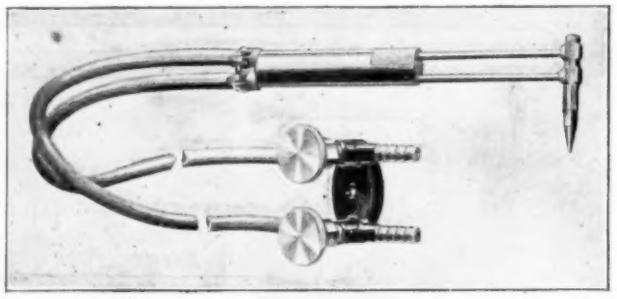


FIG. 121. THE OXWELD WELDING TORCH MODEL G

TABLE XI. PRESSURES OF GAS USED IN IMPERIAL OXY-HYDROGEN WELDING TORCHES

Welding Tip No.	Thickness of Metal to be Welded, In.	— Pressures, Lb. — Oxygen	Hydrogen
1H	1/64 to 1/32	10	10
2H	1/32 to 1/16	12	12
3H	1/16 to 1/4	15	15
4H	1/4 to 1/2	20	20
5H	1/2 in. and up	25	25

It should always be borne in mind, when consulting

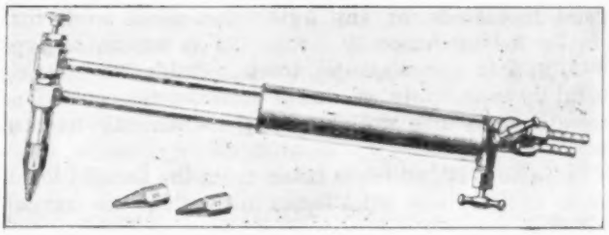


FIG. 122. THE OXWELD SHEET-METAL WELDING TORCH

a table where only pressures are given, that these pressures do *not* signify the *amount* of gas used, and that such pressures apply only to the particular make of torch mentioned. It might be possible for two different torches to use gases at exactly the same pressures as far as the gages indicated, and yet have one of these torches use several times the amount of gases used by the other. In order to make it possible for

TABLE XII. PRESSURES OF GAS USED IN IMPERIAL THREE-WAY WELDING TORCHES

OXYGEN, ACETYLENE AND HYDROGEN

Oxygen, Welding Tip, No.	Thickness of Metal, to be Welded, In.	Pressures, Lb. Oxygen.	Acetylene.	Hydrogen
1T	1/32	3	2	2
2T	1/16	5	3	3
3T	3/32	6	4	4
4T	1/8	7	5	5
5T	3/16	8	6	6
6T	1/4	9	7	7
7T	5/16	10	10	10
8T	3/8	12	12	12
9T	1/2	14	14	14
10T	1 in. and over	18	15	15

a user to estimate the *amount* of either oxygen or acetylene his outfit is consuming, three methods of estimating are given here. These methods are taken from the Prest-O-Lite instruction book. Other methods have previously been given in the descriptions of the different gases and their production. The Prest-O-Lite methods are:

Method 1. — Weigh your acetylene cylinders before starting work. Weigh again after the job is completed. Note the difference in weight in ounces, and multiply by 0.9; result equals the cu.ft. of acetylene used. When using Prest-O-Lite torches multiply the acetylene used in cu.ft. by 1.1; the result equals the cu.ft. of oxygen used.

Method 2. — Take readings of oxygen cylinder pressure gage in atmospheres before and after.

For 100-cu.ft. cylinders the difference of readings in atmospheres multiplied by 0.83 equals the oxygen consumption in cu.ft.

For 200-cu.ft. cylinders the difference in readings in atmospheres multiplied by 1.67 equals the consumption of oxygen in cu.ft.

For 250-cu.ft. cylinders the difference in readings in atmospheres multiplied by 2.08 equals the consumption of oxygen in cu.ft.

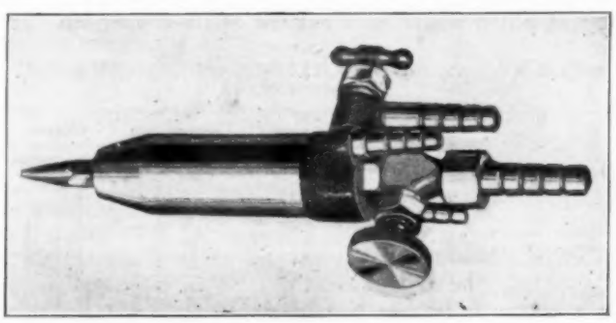


FIG. 123. THE OXWELD WATER-COOLED SINGLE-JET WELDING TORCH, TYPE W-8

When using Prest-O-Lite torches, multiply the oxygen used in cu.ft. by 0.91; the result equals the acetylene consumption in cu.ft.

Method 3. — Measure drill size of orifice in torch tip, using standard drills for measuring.

Area of orifice in sq.in. multiplied by 83 equals the acetylene consumption in cu.ft. per minute.

Area of orifice in sq.in. multiplied by 91 equals the oxygen consumption in cu.ft. per minute.

Note the minutes the torch is in use and use the above figures to estimate gas consumption.

Remember, the acetylene consumption cannot be accurately estimated from the pressure gage readings.

TABLE XIII. AREAS OF DRILLS FROM 1 TO 80 SIZE IN SQ.IN. AND SQ.MM. MANUFACTURERS STANDARD

No.	Size of Drill in In.	Area in Sq.In.	Area in Sq.Mm.	No.	Size of Drill in In.	Area in Sq.In.	Area in Sq.Mm.
1	0.2280	0.04083	26.35	41	0.0960	0.007238	4.670
2	0.2210	0.03836	24.77	42	0.0935	0.006860	4.426
3	0.2130	0.03563	22.99	43	0.0890	0.006221	4.014
4	0.2090	0.03431	22.14	44	0.0860	0.005809	3.748
5	0.2055	0.03316	21.39	45	0.0820	0.005281	3.406
6	0.2040	0.03269	21.09	46	0.0810	0.005153	3.325
7	0.2010	0.03173	20.47	47	0.0785	0.004831	3.117
8	0.1990	0.03110	20.06	48	0.0760	0.004536	2.926
9	0.1960	0.03017	19.46	49	0.0730	0.004185	2.700
10	0.1935	0.02940	18.97	50	0.0700	0.003848	2.483
11	0.1910	0.02865	18.48	51	0.0670	0.003526	2.275
12	0.1890	0.02806	18.10	52	0.0635	0.003167	2.043
13	0.1850	0.02688	17.34	53	0.0595	0.002781	1.795
14	0.1820	0.02602	16.79	54	0.0550	0.002376	1.533
15	0.1800	0.02545	16.42	55	0.0520	0.002124	1.370
16	0.1770	0.02461	15.88	56	0.0465	0.001693	1.092
17	0.1730	0.02351	15.17	57	0.0430	0.001452	0.9368
18	0.1695	0.02256	14.56	58	0.0420	0.001385	0.8930
19	0.1660	0.02164	13.96	59	0.0410	0.001320	0.8510
20	0.1610	0.02036	13.14	60	0.0400	0.001257	0.8110
21	0.1590	0.01986	12.81	61	0.0390	0.001195	0.7710
22	0.1570	0.01936	12.49	62	0.0380	0.001134	0.7316
23	0.1540	0.01863	12.02	63	0.0370	0.001075	0.6936
24	0.1520	0.01815	11.71	64	0.0360	0.001018	0.6568
25	0.1495	0.01755	11.32	65	0.0350	0.000962	0.6207
26	0.1470	0.01697	10.95	66	0.0330	0.000855	0.5516
27	0.1440	0.01629	10.51	67	0.0320	0.000804	0.5187
28	0.1405	0.01550	10.00	68	0.0310	0.000754	0.4865
29	0.1360	0.01453	9.374	69	0.0292	0.000669	0.4316
30	0.1285	0.01296	8.361	70	0.0280	0.000615	0.3968
31	0.1200	0.01131	7.297	71	0.0260	0.000531	0.3426
32	0.1160	0.01057	6.819	72	0.0250	0.000491	0.3168
33	0.1130	0.01003	6.471	73	0.0240	0.000452	0.2916
34	0.1110	0.009677	6.243	74	0.0225	0.000398	0.2565
35	0.1100	0.009503	6.131	75	0.0210	0.000346	0.2232
36	0.1065	0.008908	5.747	76	0.0200	0.000314	0.2026
37	0.1040	0.008495	5.481	77	0.0180	0.000254	0.1639
38	0.1015	0.008092	5.221	78	0.0160	0.000201	0.1297
39	0.0995	0.007775	5.016	79	0.0145	0.000164	0.1058
40	0.0980	0.007543	4.866	80	0.0135	0.000143	0.09226

In order to simplify the calculations in Method 3, the areas of the various orifices made with numbered drills are given in Table XIII. This table was calculated by K. H. Condit, associate editor of the *American Machinist*, for both square inches and for millimeters.

The Oxweld Low-Pressure Torch

The Oxweld low-pressure torch is of the true injector type. One of this make of torch is shown in Fig. 118 and in detail in Fig. 119. In this torch the acetylene is drawn into the combining tube by the injector action of the high-pressure oxygen jet, in the proper quantity to form what is known as a neutral flame; that is, one not having an excess of oxygen or acetylene. A torch of this type may be used with either a low- or positive-pressure acetylene system, although primarily designed for low-pressure acetylene, which means at a pressure of 1 lb. or less. Ten hard-drawn copper tips, shown in Fig. 120, are regularly supplied for this torch, and bodies may be had to hold the tips at 67½ or 90 deg., although the regular angle is 45 deg. The tips shown are numbered 2, 3, 4, 5, 6, 7, 8, 10, 12 and 15 and are intended for use on metal $\frac{1}{16}$, $\frac{3}{64}$, $\frac{3}{32}$, $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$ and $\frac{3}{4}$ in. thick and up, respectively.

A very light torch, weighing 9 oz. and known as

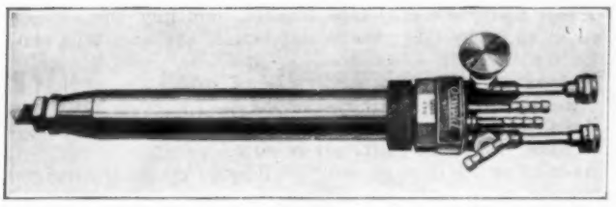


FIG. 124. THE OXWELD WATER-COOLED MULTIPLE-JET WELDING TORCH, TYPE W-5

model G, is shown in Fig. 121. This is intended for very light sheet metal, instruments, jewelry and the like. In order to secure a torch of minimum weight, the oxygen and acetylene regulating valves have been removed from the body of the torch and incorporated in a separate valve block which may be fastened in any convenient position near the operator.

Another very light torch is shown in Fig. 122. This is suitable for metals up to $\frac{1}{8}$ in. thick. In addition to the usual practice of placing needle valves in the rear body, there is also incorporated in the torch head a needle valve which gives minute control of the flame with each size of tip. Three sizes of interchangeable copper tips are supplied. It is 10 in. long and weighs 10 oz.

The Oxweld water-cooled machine torches are shown in Figs. 123 and 124. Fig. 123 is a single-jet, known as type W-8, and is adapted to work on cartridge cases, pistol magazines, or any light sheet-metal work that can be fed mechanically. Fig. 124 is known as type W-5, and is a multiple-jet torch suitable for welding metal up to $\frac{3}{32}$ in. thick, and is designed for continuous operations on tube stock or other mechanically handled work.

In Table XIV, which is taken from the Oxweld handbook, the various thicknesses of metal, the oxygen pressure, hourly gas consumption, consumption per foot and amount of wire used, are shown. In this table the acetylene is used at 1-lb. pressure.

The torch shown in Fig. 125 and in detail in Fig. 126 is made by the Messer Manufacturing Co., Philadelphia, Penn. It works on the injector principle and may be used with either low- or positive-pressure acetylene systems. This make is notable on account of the single valve in the torch itself, and the tips, which are bent, may be set at any angle radial with the torch body. The various sizes, tips and general range is practically the same as for the torches previously described.

TABLE XIV. APPROXIMATE DATA FOR USE WITH OXWELD WELDING TORCHES

Thickness of Metal In.	Size of Weld. Head	Oxygen Pressure Lb./ Sq. In.	Per Hour				Per Linear Foot		
			Speed		Gas Consumption		Gas Consumption		Oxweld Iron Wire Cu. Ft.
			Best Condition Lin. Ft.	Shop Practice Lin. Ft.	Oxygen Cu. Ft.	Acetylene Cu. Ft.	Oxygen Cu. Ft.	Acetylene Cu. Ft.	
$\frac{1}{64}$ No. 28	Model G	5	30	26	3.5	3.3	0.14	0.13	
$\frac{1}{32}$ No. 22	2	9	26	22	4.5	4.2	0.20	0.19	0.005
$\frac{1}{16}$ No. 16	3	10	21	17	6.6	6.2	0.39	0.37	0.01
$\frac{3}{32}$ No. 13	4	11	17	14	8.7	8.3	0.62	0.59	0.02
$\frac{1}{8}$ No. 11	5	12	14	11½	10.8	10.2	0.94	0.89	0.04
$\frac{3}{16}$	6	14	11	9	15.0	14.2	1.67	1.58	0.06
$\frac{1}{4}$	7	16	9	7	19.2	18.3	2.74	2.62	0.15
$\frac{3}{8}$	8	19	6¼	4½	27.6	26.3	6.13	5.85	0.3
$\frac{1}{2}$	10	21	4½	3	36.0	34.3	12.0	11.4	0.6
$\frac{3}{4}$	12	25	2¾	1½	52.8	50.4	35.2	33.6	1.4
1	15	30	2	1	69.7	66.3	69.7	66.3	2.4

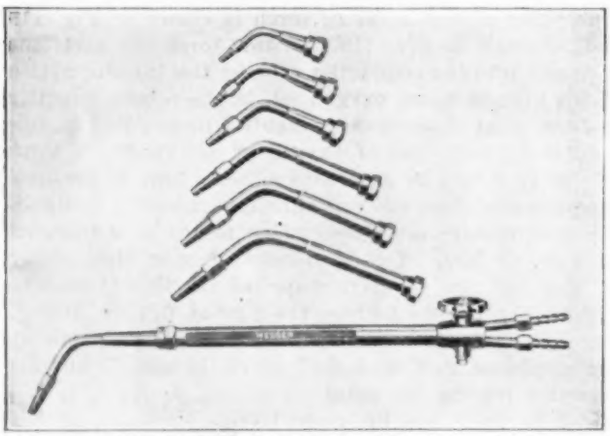


FIG. 125. THE MESSER WELDING TORCH AND TIPS

DESCRIPTION OF THE OXY-THERMALENE WELDING TORCH

An oxy-thermalene welding torch, and a set of tips, is shown in Fig. 127. Details of the head are shown in Fig. 128. One of these torches is about 17 in. long and weighs 24 oz. Referring to the detailed cut, the oxygen enters at *A* and the thermalene at *B*. The oxygen nozzle is at *C*. Screens are placed at *D*. One of the troubles with some torches is the fact that frequently a flashback will occur, reaching the oxygen nozzle in the gas chamber. Here a flame would be formed which would burn out the entire copper tip. In

TABLE XV. AMOUNT OF OXYGEN AND THERMALENE USED FOR WELDING

Tip No.	Thickness of Metal in Inches	Consumption of Thermalene, Ft.	Consumption of Oxygen with Thermalene, Ft.	Oxygen Pressure with Thermalene, Lb.
1	$\frac{1}{64}$ to $\frac{1}{32}$	2.15	2.55	1.0
2	$\frac{1}{32}$ to $\frac{1}{16}$	3.32	3.99	2½ to 3
3	$\frac{1}{16}$ to $\frac{1}{8}$	5.51	6.52	3 to 3½
4	$\frac{1}{8}$ to $\frac{3}{16}$	8.29	10.11	3½ to 4½
5	$\frac{3}{16}$ to $\frac{1}{4}$	11.78	14.21	5 to 5½
6	$\frac{1}{4}$ to $\frac{3}{8}$	16.48	20.10	6½ to 7½
7	$\frac{3}{8}$ to	21.40	27.51	10 to 11
8	to	25.00	35.01	11 to 12
9	to	33.60	54.21	15
10	to 1½	48.05	75.30	20 to 22
11	1½ to 1¾	70.35	101.62	25 to 28
12	1¾ to 2	91.10	159.20	25 to 30

the torch shown it is claimed this does not occur. It will be seen that the gas chamber is comparatively large, while the orifice leading from the gas chamber to the mixing chamber is restricted and elongated. This orifice is enlarged abruptly to the mixing chamber in the nozzle, so as to form sharp corners at *E*. The mixing chamber gradually contracts to the outer opening in the nozzle. As a result, if a flashback should occur, it will cause a whirl or eddy at the shoulder *E*, which in itself will prevent the flame from running back through the restricted channel. Moreover, such propagation of the flame into the mixing chamber will cause the gas in the chamber to be pressed back by the increased expansion and pressure, so that there will

FIG. 126. DETAILS OF THE MESSER WELDING TORCH

be only burnt gas in the restricted channel and around the oxygen tip. The result is that the flame will die out in the restricted channel between the gas and mixing chambers, so that a cutting flame is never formed at the oxygen nozzle. It is necessary, however, that these

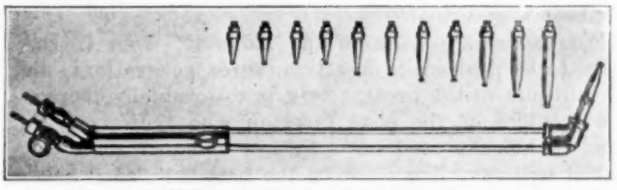


FIG. 127. A THERMALENE WELDING TORCH AND TIPS

parts should be properly proportioned to obtain the desired results.

For various welding purposes, 12 sizes of tips are made to be screwed into the torch bodies. These tips run from 2 to 4 in. in length, and the outlets vary from the size of a No. 80 to No. 33 drill. All have

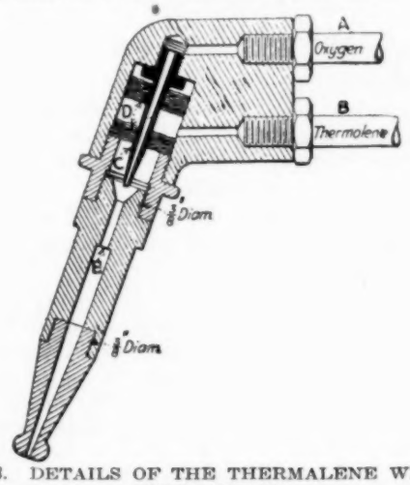


FIG. 128. DETAILS OF THE THERMALENE WELDING TORCH HEAD

$\frac{9}{16}$-in. wrench-holds on them for screwing into the torch bodies.

Table XV will furnish a good idea of the amount of thermalene and oxygen used per hour for different thicknesses of metal, the torch being fitted with the proper nozzle in each case.

Harry Tells His Uncle a Few Things

My dear Uncle:

It has been some little time since I had the opportunity to write you, and during that time much has happened. A few months ago everything was at the height of a feverish activity. Shops everywhere were running, days, nights and Sundays in frantic endeavor to furnish something—anything—to "swat the Hun." Machinists and toolmakers, the fellows with whom you and I are most intimately acquainted, were very important individuals indeed and some of them were exasperatingly conscious of their importance.

We had our troubles, of course; everybody has trouble, but ours were of a minor nature. Our toolmakers were mostly sensible fellows with families to keep their heads level, who did not really believe that the war would last forever, and that a good job before the war stood a pretty good chance of being a good job after the war, while some of the in-between jobs with their glittering financial accompaniment might prove to be will-o-the-wisps, exciting while the chase lasted, but with a bitter taste of the Dead Sea fruit for an aftermath.

Over at the Big Shop across the canal the trouble was acute. This shop is owned by a New York syndicate to which a dividend is no object so long as the stock market is active, and it has for some years been an exponent of system to the *n*th power. Its regular product is far from being munitions of war, and thus when it joined the procession of producers of war material it began at once to suffer from general debility of the system.

Cornered the Market in Toolmakers and Machinists

Operating at first on the "cost plus" basis it immediately cornered the market in toolmakers and machinists. One of our kids, not an apprentice, whose principal job was sweeping the floor and running a drilling machine on jigged work, went over and hired out as a first-class toolmaker at $4.50 per day of eight hours. This was quite early in the war; he probably got $9.00 or so later.

He first went up against the employment manager—or manageress, I forget which it was at the time—who gave him the once over, sized up his "noble brow," his "eagle eye" and his "aggressive chin," noted that these compared favorably with the large-sized chart hanging on the wall, and then passed him along to a youthful assistant who gave him a form to fill out.

On this form Tommy deposed that he was 20 years of age; male; white; born in U. S. A.; unmarried; had no children; was several feet and some inches high; and weighed 119 lb. in his stocking feet. Much of this was true. He further declared that he did not drink; did not use tobacco; smoked cigarettes occasionally (I have always suspected that his cigarettes were made of old rope); was strictly honest; and that his habits and deportment were excellent. Some of this was true. He might have added that he had never been in jail, though I do not recall that that question was asked—on the blank.

Passing to the second entrenchment, Tommy was given a blank on which he stated that he was an expert toolmaker, had served a regular apprenticeship with

the Gatchet Machine Co. and had worked for two years in the capacity of toolmaker with the Hookemsnivy Manufacturing Co. Also that he was perfectly familiar with the use of a micrometer, a dial indicator, and a sine bar, and that he had a kit of tools. None of this was true.

He further averred that he wanted $5.00 per day, which statement was unimpeachable, though quite conservative.

At this stage the prosecution rested. Tommy also rested—for two hours—at the expiration of which period he was notified by an important-appearing youth to come in for examination at 10 o'clock on the following morning.

At the appointed time Tommy presented himself before the "examining board." He had spent some time the previous evening "boning" for the examination with the help of a friend who had been through the mill, and he could read a micrometer as readily as the boy at the head of the Primer Class reads "See The Cow Jump." Indeed, I think he could read it better than his examiner, for when he was handed a plug gage plainly marked ⅝ in. he promptly read it "point six two five," which, I'll bet a cookie, wasn't right if the tenths were to be considered.

Tommy Demonstrates the Sine Bar

The youth in charge of the sine bar gave Tommy a few practical examples in the use of this tool and required him to demonstrate it, which he did, although his mathematics were not beyond criticism. After a few more unimportant questions, that could have been answered by any ordinarily intelligent boy after a couple of hours' study under a competent instructor, Tommy was on; his poor showing in trig had cost him 50c. per day, but he was a full-fledged certificated toolmaker without having had a single day's experience, and knowing practically nothing of the business.

This would have been a joke if it were an isolated case and his employer had to pay him, but unfortunately there were many thousands of him and the paymaster was the American people.

Now that the tide has turned the other way the market is flooded with young Tommies who are not toolmakers, may never be toolmakers—because before they can become such they must accomplish the practically impossible feat of unlearning many things they know, that are not so—yet they have been called, and are calling themselves, toolmakers; have worked for toolmakers' wages, and have never learned that they are not toolmakers. These young men are not going back to the level of unskilled labor without a struggle and there seems to be a disposition in some quarters to accept them as they are and build new machinery to fit them.

So long as the supply exceeds the demand, the natural law of selection will prevail and the general trend will be toward a level of greater skill, knowledge and efficiency. When, on the other hand, the demand is greater than the supply, the tendency is toward degeneration unless it be combated by efficient and well-thought-out methods.

Though it now appears as if the supply was going to exceed the demand, it is a very wise or a very ignorant man who will predicate what the condition will be a year hence. For this reason some measures should be adopted first to determine to what avocation each of our young men—and possibly our young women—is best adapted, and second to devise some means by which each individual may be best fitted to assume the duties of that avocation.

Years ago the principal determining factor was heredity. A boy wanted, and was expected, to follow in his father's footsteps. This was a sort of natural progress along the line of least resistance that produced results not wholly undesirable. We had (and have now) machinists, than whom there are none better in the world, whose fathers, and whose fathers' fathers were machinists before them.

Keeping the Trade in the Family

This tendency to "keep the trade in the family" may or may not have developed a natural genius, but it cannot be denied that the training of a boy whose father and grandfather were machinists was much more intensive and began at a much earlier age than that, for instance, of a boy whose father was a minister, and who never saw the inside of a shop until he was 15 years or so of age.

There were disadvantages also. We still have with us men who know things that are not so, just because "father said so," and who are conservative to the point of suspicion when anything new is discovered in their field, but even at the risk of being classed with the mossbacks and hardshells I hold to the opinion that this system brought forth better workmen than the present-day method of choosing a trade solely because it pays the best wages.

We cannot go back to the old way, even if that were to be desired, in less than three generations, and to continue in the present way is to gradually increase the troubles of the poor foreman who "can't get the kind of help he used to." Nature will provide a way, but it will very likely not be the best way, so it seems to be up to us to provide a means of assorting and educating the rising generation, as well as re-educating a portion of that already risen.

HARRY, SR.

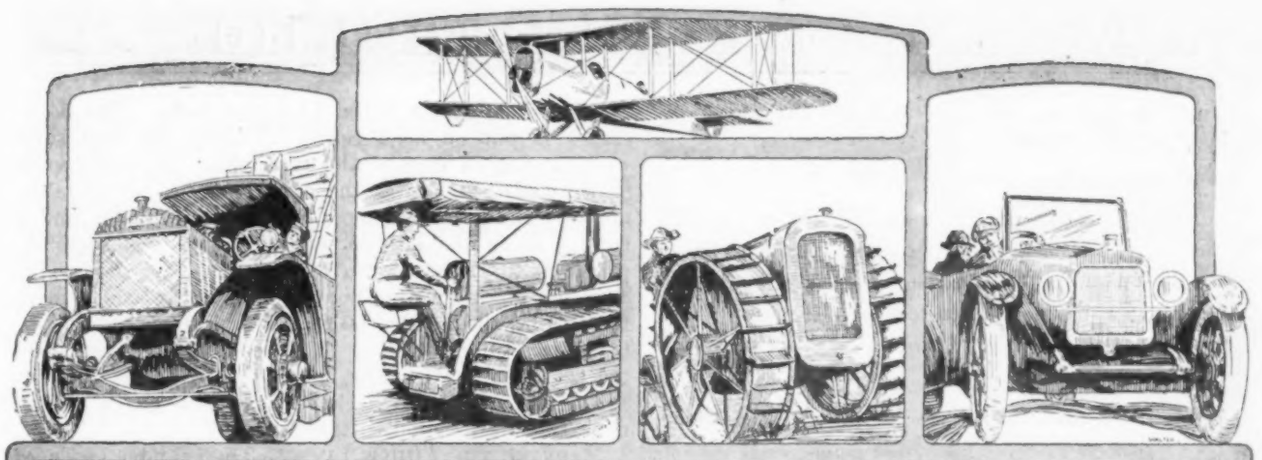
How Would You Prevent This Grinding Trouble?

BY J. H. HOLLINGER

With reference to the above inquiry by John Vernon published on page 705 of *American Machinist*, if Mr. Vernon had given a little more information as to how he ground the piece it would have served as a guide to others in solving his problem.

Assuming that the work is to be done on a regular surface-grinding machine, the piece should be placed on true parallels (to provide clearance for the bracket depending from its under side), and sounded to find out if it bears solidly. It should be underlaid with paper at all points not in contact with the supporting surface so that there will be no distortion or springing either from wheel pressure in grinding or from pressure in whatever manner applied for holding the work in place.

The work may be held in the ordinary form of machine vise by means of suitable fingers or, by using special parallels, may be held on a magnetic chuck. A wheel of medium grain and rather soft texture should be used for the grinding operation, and its surface should be kept sharp to avoid the generation of undue heat which is usually the cause of warping.



AUTOMOTIVE CONSTRUCTION

Operations on the Liberty Motor Cylinders

II. Machining Operations

By H. A. CARHART
Mechanical Engineer, Lincoln Motor Co., Detroit, Mich.

The manufacturing of steel cylinders in large quantities, especially in view of the extreme accuracy demanded, involved new problems which may have a bearing on automobile building of the future. The illustrations give a good general idea of the methods employed in the earlier operations and the data as to operations give complete information as to speeds, feeds, etc.

IN VIEW of the fact that the machining of Liberty motor cylinders in great quantities is now a thing of the past, it does not seem advisable to go into the extreme details of the manufacturing methods employed. On the other hand, as there seems likely to be an increase in the use of steel cylinders, it is felt that the experience gained should not be lost, but should be recorded in sufficient detail to enable others to profit by it as occasion may arise. With this in view, these articles have been prepared in the belief that they may prove beneficial to the industry as a whole, and that they contain many suggestions which can be modified and adopted for many other uses. This will be followed by articles outlining other essential parts of the motor. Beginning with a list of the operations, there follows a brief description of the main operations and the illustrations of the fixtures and machines used. This also gives the speeds, feeds and time required for each operation.

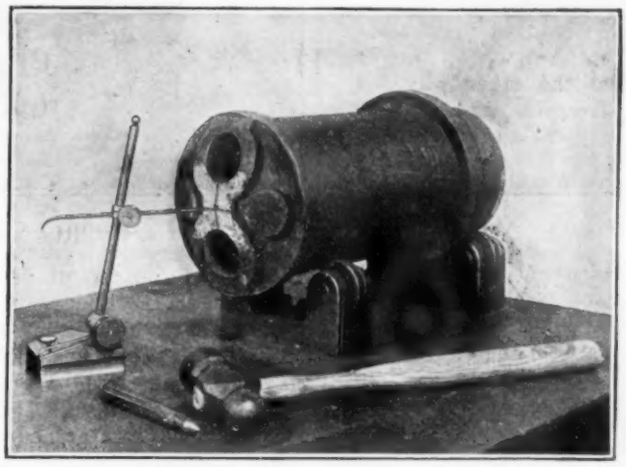


FIG. 1. CENTERING THE CYLINDER FORGING

One of the most important and vital parts of the Liberty motor is the steel cylinders. The forging of these was perfected by the engineers of the Ford Motor Co., and all the cylinders used were forged in their plant, as has been described in a previous article.

In the following machine operations at the Lincoln Motor Co. performed before welding the elbows and water jacket, the average production covering the period from Mar. 3, 1918, to Nov. 23, 1918, was 2.34 finished cylinders per man each day of nine hours. For the period from Nov. 18 to Nov. 23, the production was 3.26 perfect cylinders per man for a nine-hour day. When the rough forging went into the shop it weighed 47 lb. After the machining was completed, it weighed 11 lb., 6 oz. From the perfect cylinders alone, this shop produced 3,967,231 lb. of chips and turnings; imperfect cylinders not being computed. Each man in the first operation handled 1000 cylinders, weighing 47,000 lb. or 23½ tons per man each nine hours. The rough-boring operation removed 9 lb. from each cylinder or 4½ tons of borings per day. The operation of recentering was performed by one man. The cylinders at this period weighed 33 lb. 7 oz. each and were lifted on the drilling machine and lifted off again. The production was from 850 to 1000 per day, so that this man handled more than 33 tons of steel in nine hours.

CENTERING.—The centering was formerly done by scribing the point central with the outside of the dome. A large loss resulted because of the dome not being central with the body, and the bore would not

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clean up So this was changed to locate the center by the body of the cylinder.

MACHINING OPERATIONS ON CYLINDER BARREL

Inspecting the rough stock.
Locating and countersinking the center in rough-boring (one helper).
Turning $6\frac{7}{32}$ in. diameter and $7\frac{7}{32}$ in. diameter for chucking surfaces (one helper).
Marking the finish line on the bottom end of the cylinder.
Rough-boring $4\frac{3}{4}$ in. diameter.
Rough-boring $4\frac{3}{8}$ in. (Acme turret lathe only, one helper to run four machines).
Roughing and finish-boring the face inside of the dome face to the finish line and recess.
Drilling the center.
Re-centering the open end.
Inspecting.
Re-centering the top of the cylinder, turning with the bore.
Rough-drilling the portholes to $2\frac{1}{4}$ in.
Rough-turning the outside diameter and finish-turning the bolt flange for the roller rest.
Rough-straddling the flange and rough-forming the water-jacket flange. Finish-turning the taper at the top and the diameter above the water-jacket flange, roughing a 1-in. radius below

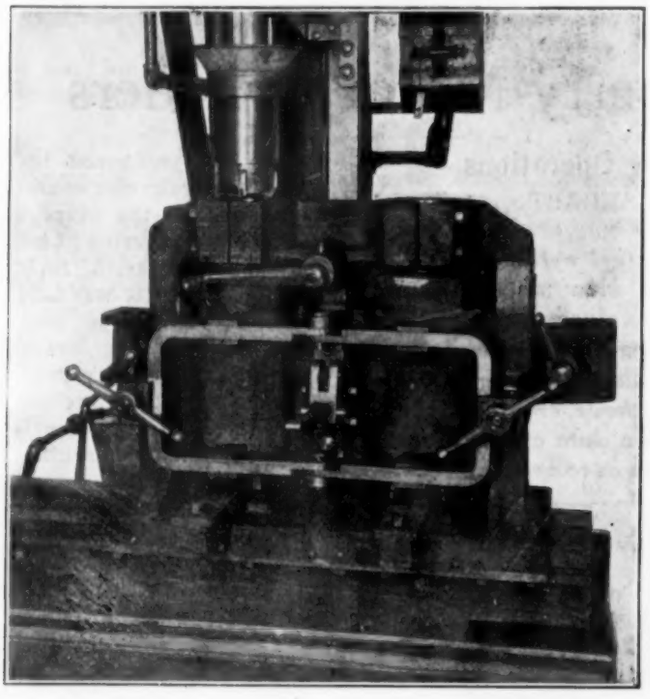

FIG. 2. ROUGH-BORING THE CYLINDERS

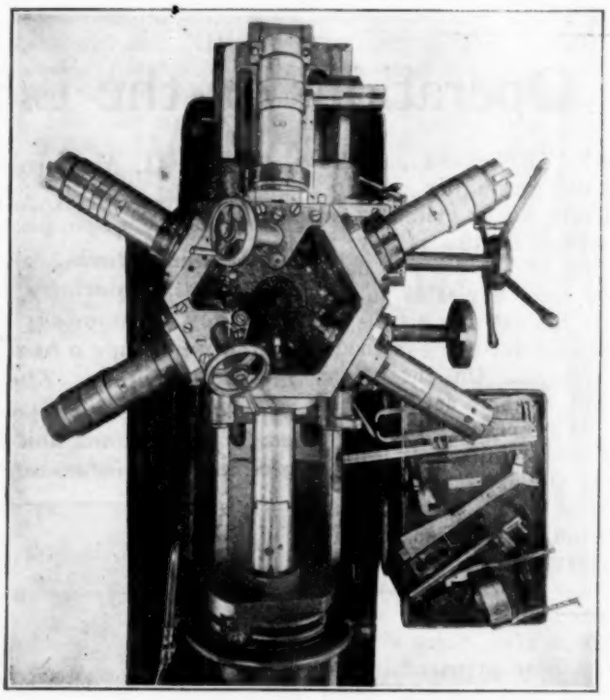

FIG. 3. BORING AND FACING THE DOME

the taper, $\frac{1}{4}$-in. radius on the lower end, and finish-turning $5\frac{7}{16}$ in. and 5 15/64 in.
Finish-turning between ribs; finish-straddling the flange.
Turning the bottom rib, forming the top of the dome, and burring the ribs.
Finish-turning between the ribs and flange, turning the bottom radius, and recessing the water-jacket rib.
Inspecting.
Boring and turning the portholes.
Drilling and turning the spark plug holes.
Rough-facing the radius on the face of the cylinder.
Roughing the outline of the bolt flange.
Rough-milling the two parallel sides.
Finish-milling the two parallel sides.
Profiling the dome. (Girl price to be same as man price.)
Profiling the outline of the flange.
Chipping and filing the dome.
Washing.
Inspecting finished stock

The fixture shown in Fig. 1 was used, and the cylinder rolled so that quartering lines were scribed with a surface gage. The point was then marked with a prick punch. The center was then countersunk with a center drill on a 16-in. Leland-Gifford drill press at a rate of about 900 cylinders in nine hours by two men.

TURNING THE LOCATING SURFACES.—The cylinder is put on an 8-in. x 36-in. Lo-Swing lathe. The dome center is put on head center of lathe and two solid driving fingers engage the portholes. A cone center in the tailstock locates the open end. A cut is taken on the outside of the dome $6\frac{1}{32}$ in. in diameter and a cut $7\frac{7}{32}$ in. in diameter on the bolt flange. These points are used to locate future operations. The production was 300 pieces in nine hours for one man and helper; the cutting speed being 50 ft. per minute with a feed of 0.054 in. per revolution. The special tools used were two Lo-Swing tool blocks, a No. 5 Hoover insert point for center and a tailstock center. The gages on the operation were snapped tight.

MARKING THE FINISH LINES.—The cylinder is placed on a rolling fixture and adjusted so the top and bottom of the bolt flange will clean up, and that about $\frac{3}{32}$ in. stock is left on top of dome with finish material on bottom end of cylinder. A finish line is then scribed with a sharp instrument at the bottom of cylinder. This is prick punched and all future measurements taken from this line. Work of the previous operations is also inspected here. The capacity of this operation was about 600 in nine hours by two men.

ROUGH-BORING THE CYLINDER.—This work is performed on a Baker drill, as in Fig. 2. The fixture carries two chucking stations so that one can be emptied, cleaned, and reloaded while the other is in operative position The cylinder rests on two blocks between the bosses and the top of the dome. It is pushed in so that it rests against two fixed jaws, and the swinging clamp is then tightened. The fixture carries hardened bushings which are lubricated after each operation with a mixture of graphite and oil, to prevent the boring bar from binding under the stress of the work.

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The cutting speed is about 75 ft. per minute and the feed per revolution is 0.013 in. at the start but only 0.010 in. through the center increased to 0.013 in. for the remainder. Hand feed can be used for a part of the way at the top and bottom of the bore if preferred. The boring bar is ground on centers to micrometer dimensions, so that all four lips cut an equal amount. The capacity of one machine was about 75 pieces in nine hours, operated by one man.

BORING AND FACING THE OPEN END AND MACHINING THE INSIDE OF THE DOME.—The cylinder is placed in the chuck, and the port bosses are locked against the two bosses in the back of the chuck as a means for driving the cylinder. The outside finished locating rings of the cylinder rest on two fixed jaws which are bored to fit these spots. There is a swinging clamp for each of the said locating rings. These are clamped down firmly onto the cylinder. The machining operations are performed on a 3¼-in. Acme flat-turret lathe, as illustrated in Fig. 3, which shows the tool layout. The recessing tools with handwheel adjustment, and some of the gages are shown.

First.—Feed the rough boring bar in part way before using power feed. This cuts the chamfer to $4\frac{5}{8}$ in. in diameter.

Second.—Feed the finish-boring bar in part way, and then the balance by power feed. This should bore the cylinder to a diameter of 4.937 to 4.945 in. The open end is then faced back to the finished line, and the bore chamfered slightly.

Third.—Rough-machine the dome allowing not more than $\frac{1}{32}$ in. for finish.

Fourth.—Rough-machine the recess, feeding the special form tool down in a vertical position to within $\frac{1}{32}$ in. of the required diameter.

Fifth.—Finish-machine the dome to the correct depth in relation to the face of the open end.

Sixth.—Finish-machine the recess to a correct diameter, making certain that this cut blends with the finish cut of the dome. In this operation, care must be taken that the bore is kept central with the outside locating rings of the cylinder, and that it is reasonably smooth. The finish in the dome must also be smooth, and the radius correct when measured from the face of the open end. This also applies to the finish radius and angles.

RE-DRILLING THE CENTER.—A $\frac{3}{16}$-in. drill set for the correct depth is used for this operation. The object is to prevent the center reamer from breaking or from touching the bottom of the hole, causing it to run out of true. About 855 pieces were usually produced by one man in nine hours.

CHAMFERING THE OPEN END TRUE WITH THE BORE.—The cylinder is placed on an expanding pilot and turned on the pilot until the drivers are engaged. When the pilot is expanded, the cylinders are chucked. The chamfering tool is fed up against chamfer of the bore, until it is cut true and $5\frac{1}{16}$ in. in diameter. The feed was entirely by hand, the machine cutting speed being about 57 ft. per minute. This was satisfactorily performed on a 16-in. Reed lathe at a rate of 800 cylinders in nine hours. One man operated the machine.

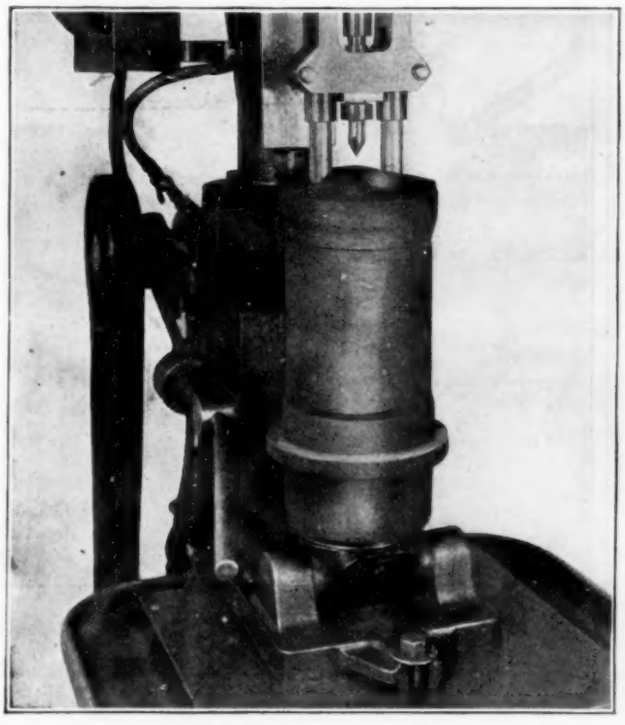

FIG. 4. RE-CENTERING TRUE WITH THE BORE

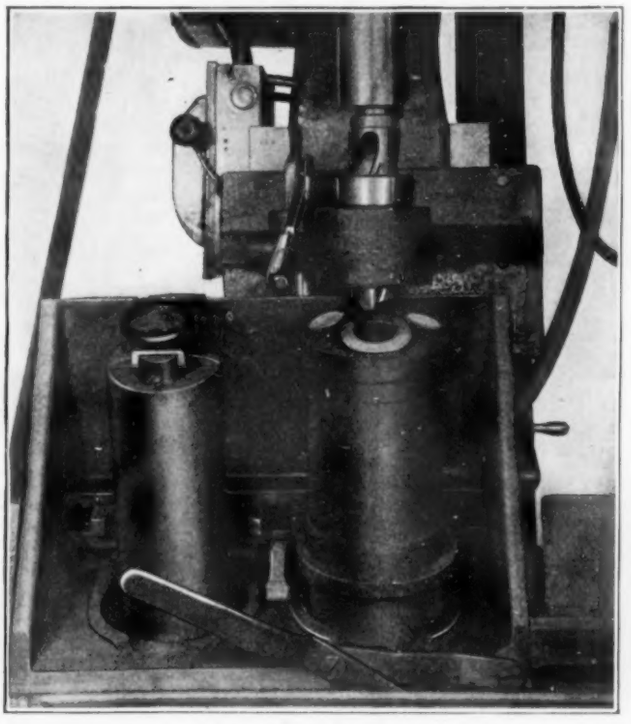

FIG. 5. ROUGH-BORING THE PORTHOLES

RE-CENTERING THE DOME TRUE WITH THE BORE.—For this operation a 16-in. Leland-Gifford drill is employed. The cylinder is placed on an expanding fixture shown in Fig. 4, and swung into a vertical position. Expanding plugs in the top of the fixture align the cylinder with the drill-press spindle, the lower end fitting closely over the locating points on the fixture. The center reamer on the drill-press spindle is then fed down until a perfect center is obtained; the cylinder is then removed, put on a solid pilot the full length of the bore, and with an indicator on the chamfered lower end, and one on the center of the upper end, the centering is checked for concentricity.

The reamer is a 60-deg. commercial center reamer. There is a special test fixture for centers, a guide for centering the fixture, and a holder for the centering reamer.

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This machine produced 850 pieces in nine hours, one man doing the centering, and one man checking the work.

ROUGH-DRILLING THE PORTHOLES.—The portholes are rough-drilled to 2¼ in. in diameter on a Baker drill. The cylinder is held in a special fixture, Fig. 5, and turned until the bore-hole bosses lined with the gage as shown. The gage is removed, the first hole is drilled and, while this is being done, the other side of the fixture is being loaded in the same manner as the first. The fixture is then slid along; the hole in the second cylinder is drilled, while the first cylinder is turned on the fixture for drilling the other port. The cutting speed was approximately 59 ft. per minute, and 280 pieces in nine hours was the capacity of one machine.

TURNING BETWEEN THE FLANGES AND REMOVING THE EXCESS MATERIAL.—This is performed on the same type of machine as the previous operation, and is handled in the same manner. The capacity on this operation was 120 pieces in nine hours with one operator. The cutting speed was about 38 ft. per minute with 0.090 in. feed per revolution.

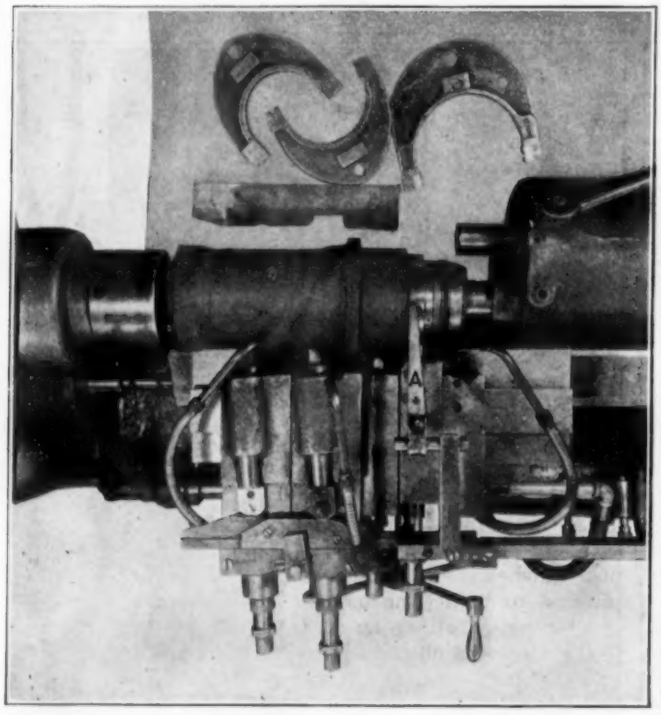


FIG. 6. TURNING THE LOWER END OF THE CYLINDER

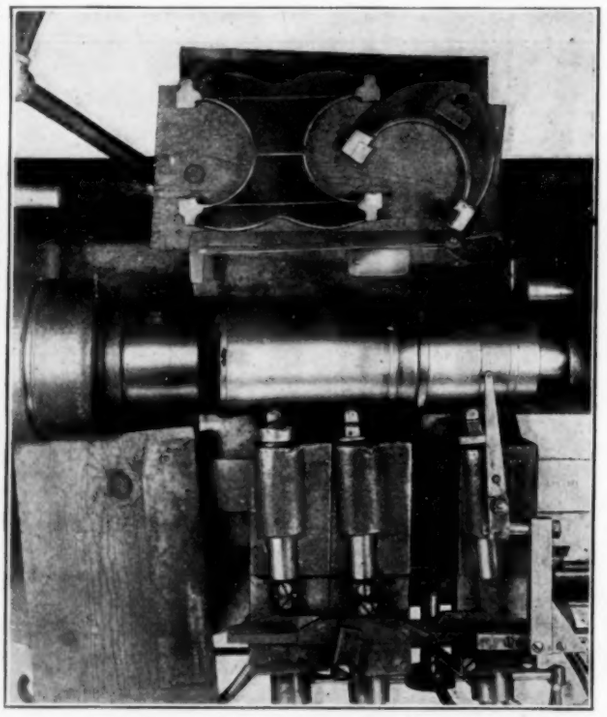


FIG. 7. FINISH-TURNING THE PILOT END

TURNING THE LOWER END AND FLANGE.—In this operation, the lower or pilot end of the cylinder below the flange is rough-turned; the lower side of the bolt flange is turned to the proper dimension from the lower end. The diameter of the flange is also turned to use for locating in future operations. The barrel of the cylinder is rough-turned about the bolt flange, and the angle formed at the top. This work was performed on an 8-in. x 36-in. Lo-Swing lathe. The center of the dome is located on the head center of the lathe, with driving fingers entering the portholes. The open end is supported on a cone center in the tailstock.

An indicator finger *A*, Fig. 6, which is fastened to the cam bar, is then located against the lower end of the cylinder. The cam bar is placed in a correct relation as shown by this indicator, so that the angle at the top of the cylinder will be turned in a correct relation to the lower end. When the cam bar has been so adjusted, the indicator is swung out of position, and the carriage moved along until the tool begins cutting; then the power feed is engaged. The first tool does the rough-turning below the bolt flange, and rough-faces the lower side of the flange. The second tool turns the outside diameter on the bolt flange. The third tool operated by the cam bar rough-turns one-half the length of the barrel above the bolt flange. The fourth tool, also operated by the cam bar, rough-turns the upper half of the barrel and the angle of the dome. The capacity of this machine was 85 pieces in nine hours, with a cutting speed of about 38 ft. per minute, the feed was 0.030 in. per revolution.

FINISH-TURNING THE PILOT END OF THE CYLINDER.—This operation consists in turning the pilot end below the flange, and turning the barrel and the side of the dome to the blueprint dimensions. It is done on the same type of machine and handled in the same manner as the two preceding operations. Fig. 7 shows the tools and gages used.

The capacity per machine was 140 pieces in nine hours with a single operator; the cutting speed 68 ft. per minute with a feed of 0.030 in. per revolution.

FINISH-TURNING SIDES OF THE BOLT FLANGE.—This operation consists in finish-turning the lower end or pilot portion of the cylinder; facing bottom and top of bolt flange, forming the ¼-in. radius; finish-turning between the ribs, and rough-facing between the flanges.

AUTOMOTIVE CONSTRUCTION

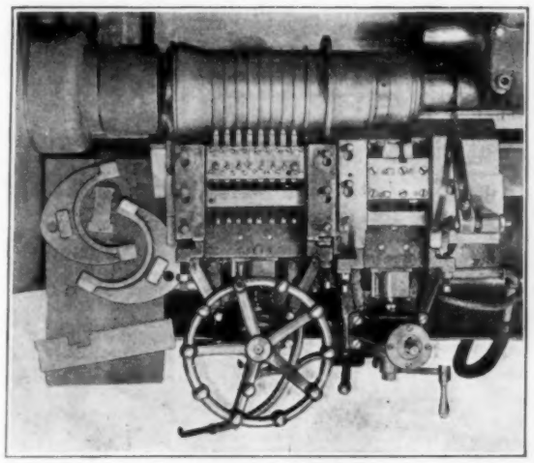


FIG. 8. TURNING THE RIBS

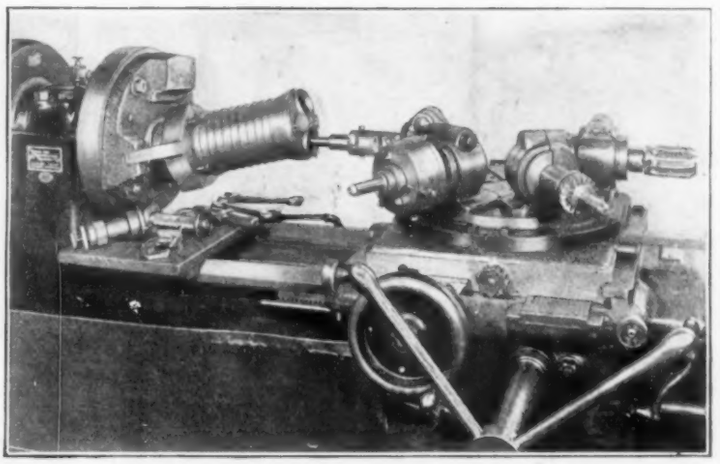


FIG. 9. BORING AND FACING THE PORTHOLES

This is performed on a Lo-Swing lathe as in Fig. 8. The production was 120 pieces in nine hours, operated by one man.

FORMING AND FACING THE WATER-JACKET FLANGE.—This is done on a 24-in. Lodge & Shipley lathe, and includes finish-forming and facing the water-jacket flange; finishing the 1-in. radius above the top rib; finishing the $\frac{3}{16}$-in. radius at the top of the dome, and filing the corners of the ribs. The cylinder is placed in the lathe, the dome center is located on the head center of the lathe with the driving fingers entering the portholes. The open end of the cylinder is supported on the cone tail center of the lathe. The tool is then adjusted to the correct relation by using a thickness gage between the forming tool and the water-jacket flange. Before removing piece the corners are filed. The capacity of this machine was 300 pieces in nine hours with one operator; the cutting speed about 68 ft. per minute, and hand feed used.

FINISHING THE DIAMETERS BETWEEN THE FLANGES.—In this operation, the water jacket flange is recessed and a $\frac{1}{4}$-in. radius finished on the bottom end of the pilot. It is performed on a 24-in. Lodge & Shipley lathe, very similar to the preceding operation. The capacity was 300 pieces in nine hours with one man; the surface speed about 68 ft. per minute, and hand feed used.

BORING AND FACING THE PORTHOLES.—This work is done on a 2$\frac{1}{4}$-in. Acme flat-turret as in Fig. 9. The cylinder is held on an expanding sleeve and is located by the plug which fits in the end of the fixture and in the rough-drilled port. A screw clamp is assembled to the cylinder bolt flange and fixture. The locating block is then removed and the expanding sleeve tightened within the cylinder. The first step is to rough-bore, counterbore, and face the port. In the next position of the turret, ream the hole $2\frac{7}{16}$ in. in diameter. The third position forms the outside of the boss and the next finishes the face counterbore. The cylinder is then indexed to bring the other porthole into position for machining. Cutting speed is 68 ft. per minute. The production was 90 pieces in nine hours for one man.

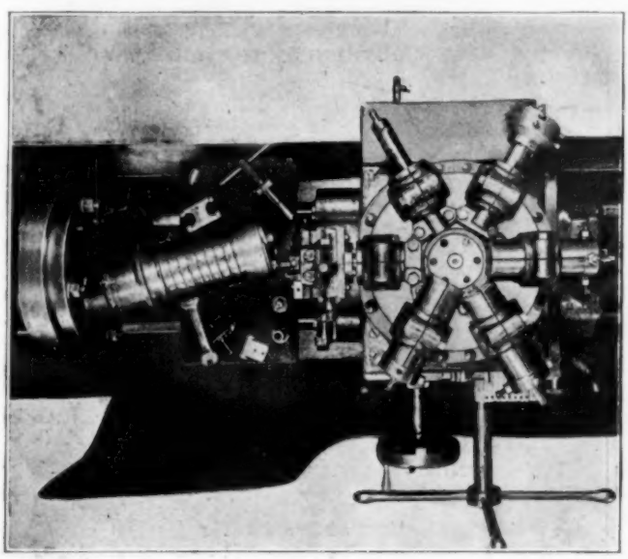


FIG. 10. UNDERCUTTING THE SPARK-PLUG HOLES

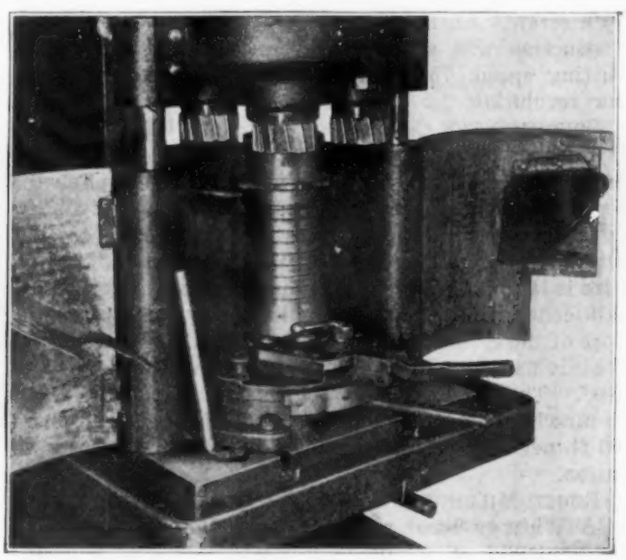


FIG. 11. ROUGHING THE BOLT FLANGE

AUTOMOTIVE CONSTRUCTION

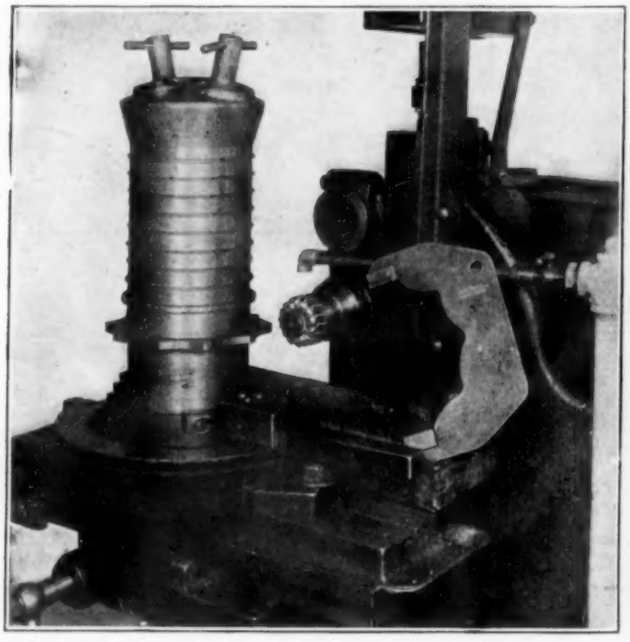


FIG. 12. MILLING FLATS ON THE BOLT FLANGE

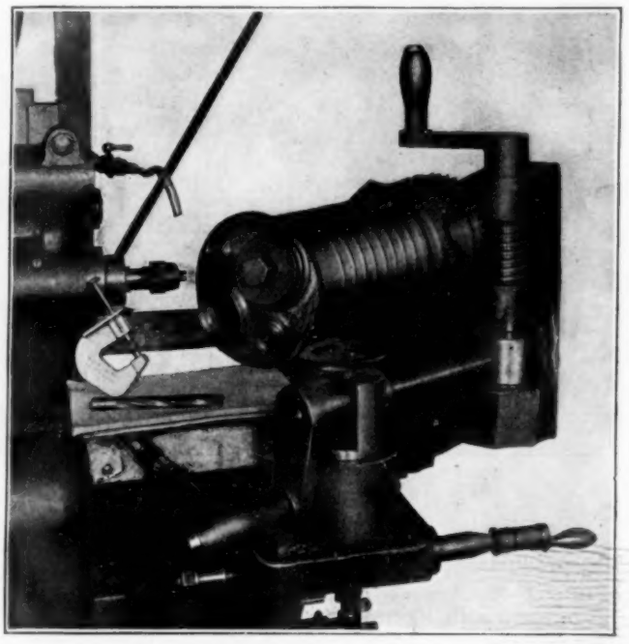


FIG. 13. FINISHING THE TOP OF THE CYLINDER

DRILLING, FORMING AND UNDERCUTTING THE SPARK-PLUG BOSSES.—This is done on a 2½-in. Acme flat-turret lathe, as in Fig. 10. The cylinder is held on an expanding sleeve. A locating plug is used in the porthole in locating the piece. The machine is operated at a high speed to center and drill, then slowed down for the following operations. The production was 90 pieces in nine hours and was handled by one man; the cutting speed was about 73 ft. per minute.

ROUGHING THE RADIUS ON TOP OF THE DOME.—A Baker drill is used for this operation. The cylinder is placed on a pilot and located by a spark-plug hole. The fixture is capable of being slid to and from the working position and adjustable to four positions. When under the spindle of the press, it is supported sideways by a screw. About $\frac{1}{32}$ in. was left for the finished cut. Production was about 400 pieces in nine hours; the cutting speed, 75 ft. per minute, and feed 0.013 in. per revolution.

ROUGHING THE CONTOUR OF THE BOLT FLANGE.—This is done on a multiple-spindle attachment to a Baker drill, Fig. 11. The cylinder is placed, bottom up, on the fixture, locating by means of a porthole and clamping by a cam lever. Four cutters are used which cut out alternate spaces between the bolt positions. The fixture is then indexed to cut the intervening spaces. There is a central pilot on the spindle head which enters the bore of the cylinder and preserves the alignment. Power feed is used during the cut with an automatic trip of feed. The production of the machine was 450 pieces in nine hours with one operator; the cutting speed about 63 ft. per minute, and the down feed 0.032 in. per revolution.

ROUGH-MILLING THE PARALLEL SIDES OF THE FLANGE.—A Whitney hand miller is used, the cylinder being held upright on a pilot and located by a plug in the portholes. The fixture has a two-position index, and about $\frac{1}{32}$ in. is allowed for the finish cut as in Fig. 12. The capacity was 600 cylinders in nine hours for one man; the surface speed of cut, 188 ft. per minute.

FINISH-PROFILING THE RADIUS ON TOP OF THE CYLINDER.—This operation is also performed on a Whitney hand miller, Fig. 13. The cylinder is placed on the pilot and clamped by the plug in the porthole. To assure the cylinder always being on a line with the center of the spindle, the machine table is secured by dowel pins against any movement in either direction. The pro-

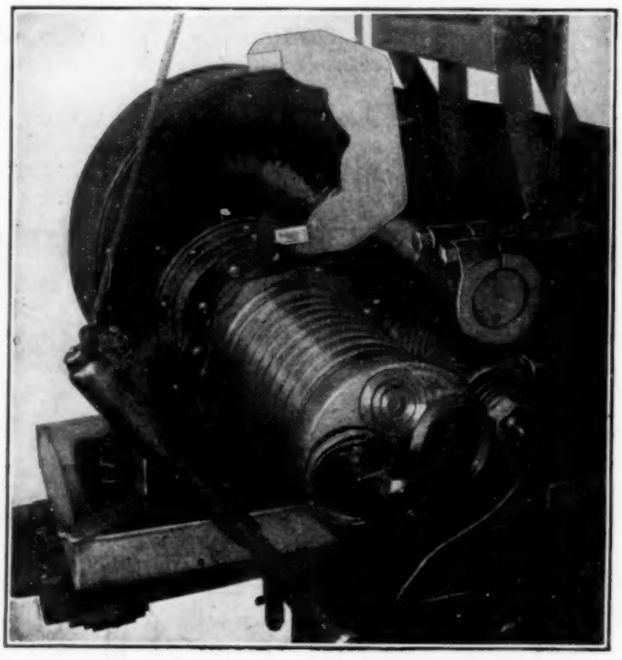


FIG. 14. FINISHING THE BOLT FLANGE

duction was 90 pieces in nine hours and a woman operator was used; the cutting speed about 110 ft. per minute.

FINISH-MACHINING THE CONTOUR OF THE FLANGE.—A Whitney hand miller is used, Fig. 14. The contour cam is carried on the fixture on the guide roller, held against the cam by weights. In starting the machine, the feed is let in slowly until the roller rests on the cam. The fixture is rotated by the power feed. The cylinder is located from the portholes. The cutter-size must be maintained to insure correctness of the work. The capacity was 65 pieces per machine. One woman operator attended three machines; the cutting speed was about 110 ft. per minute.

FINISH-MILLING THE PARALLEL SIDES OF THE BOLT FLANGE.—A similar hand miller is used. The operation is the same as for rough-milling, as previously described. The capacity of this machine was 900 pieces in nine hours.

CHIP AND FILE DOME.—The chipping was done with an air chisel while the cylinder was held on the fixture. Two men finished 750 cylinders in nine hours.

Johnson Starts to Reform His System

BY JOHN R. GODFREY

Have you "pink slipped" the interest out of the job in your shop? That's what Johnson found was one of the troubles in his. He's planning several ways to try and put it back. He knows he can never go back to the old shop methods, but he's trying to put himself in the other fellow's shoes and see how things look from his standpoint. It's a plan worth thinking about.

I DROPPED in to see Johnson the other day (he of the scientific Santa Claus experience) just to see whether he had really reformed or had blackslid, after calling down the management artists for the benefit of the assembled multitude. I wanted to see whether it was just gallery play to appease the wrath of the gods of the machine shop, or if it was an honest-to-goodness reformation.

Johnson was in his office, and as he had a sort of happy smile on his face I felt sure something pleasant had happened since I last saw him, because he wasn't happy a bit at that time.

"I'm darned glad to see you, Godfrey," he said, "and I'm equally glad you didn't come around butting in much sooner. It took me a lot of time and some hard thinking to get things back where the boys think I'm half-way human instead of wearing horns and a tail with spikes on the end. 'Twas some job, but 'twas worth it.

"This notion that you can play you're a little tin god and have some one else stand between you and the boys in the shop is all bunk, take it from me. It don't work! They don't want any benign heavenly smile when the old man comes around, but they do want to know the old codger is at least half human. And they do now.

"First thing I did was to sit down at home and do some tall thinking. I harked back to the little old shop where I served my time and where the boss was 'John' to all except the cubs. There wasn't a man in the shop who wouldn't work his head off on a rush job or who wasn't as happy in thinking up a new and better way to do a job as though it had meant dollars in his own pockets—which it didn't. So I set myself to thinking out what the difference was and why things had changed from the old-time coöperation to the state of armed neutrality and suspicion on both sides. And I believe I've found out a few things that make the difference.

"Then I called in one of the young firebrands from the shops and told him to do his worst. Promised him political and financial amnesty if he'd tell me just what he thought of me and the whole shebang and what he'd do if he was boss. And he told me good and plenty. Told me so many things that made me look so much like a piker and an 'iron duke' that I didn't know my own picture. And the great trouble was that most of it was true.

"I told him of the old shop and how we all worked nights and Sundays without a murmur if 'twould help the old man out, and never a thought of time and a half or double time. Thought I had him there, but he came back with a wallop that nearly floored me.

" 'Did your old boss sport a new horse and buggy the next week after such a job, Mr. Johnson?' he asked. 'Do you remember that rush job we did last winter? We worked nights for two months, straining our eyes and busting our backs. Got time and a half to be sure. And at Christmas we got a little old five-dollar gold piece, but you bought three new automobiles for Christmas for the family. The boys didn't exactly 'cotton' to the way the thing divided up.

ASSUMING MEN HAVE NO BRAINS

" 'But it isn't only the money Mr. Johnson, though that comes in mighty handy on rent day. There's another reason—you boys in the old shop remember it so pleasantly. You knew what was going on, you helped plan out the work and you took a real, live interest in it. If the old man had come out and loaded on you a dope sheet that had the ten commandments backed off the boards, that practically told you what an insignificant, hopeless idiot you were, and on that account, you must pick up the chuck wrench with your left hand, the work in your right, place the work in the chuck with the right hand, put the wrench on the chuck with the left hand and tighten it, and 47 other things that you knew already, I wonder if you'd have been wild about the job?

" 'Instead of that the old man came along with a sketch and said, "Hey, Bill, make one of these for

the Jackson grist mill. He's in a hurry as it's holding up your meal for griddle cakes next fall." Put it up to you and told you *why*. Of course you were interested—so would any good mechanic be interested. But how much interested would you be in the job I drew this morning?

"'Fourteen hundred rocker-arms for that old hay press, with every last detail laid out for me and a time given for almost every movement of my hands. This happens to be a case where I know the job from A to Izzard, while the young squirt up in the planning department never saw one of the animals in action. He's figured up the number of feet of holes to be drilled, the square inches of surface to be finished, and he's made a price that's a joke—not on me but on you. I can make 10 dollars a day and not half try—but I don't dare and you know it. I wouldn't follow his schedule within a hundred miles because as I said before, he never even shook hands with the job without fur-lined gloves on.

Doubling Shop Capacity

"'He's howling about production, but he's cutting it way down by prescribing methods which belong in college and not in a real machine shop. You're doing your little bit in keeping down production too by having a wage "dead line" that none of us dare pass, unless he's going to quit anyhow and don't care a cent what happens to the other boys after he's gone. If I made 10 dollars a day on that job you'd have heart-failure and the alleged planning expert would be up on the carpet in no time. And yet you forget that I'd be doubling your capacity to make these rocker-arms, for a mere five bucks a day in wages. No more machinery, or shop space, or overhead than before.'

"He told me a lot of other things which didn't set well but which were equally true, and while he didn't have a whole lot of helpful suggestions as to what should be done, he jolted me so that my thinker got real busy and I believe I've made a start in the right direction. I haven't fired the young squirt of a planner, but I've clipped his wings and he'll be quite a lad some of these days. Instead of doing his high-brow thinking all by his lonesome in the star chamber, he calls in the foreman of the department and at least one of the good workmen, to get their ideas as to how the piece should be made. This works two ways: It shows the shop men that the planner isn't such a jackass as he looks, and the planner has learned that the men on the job do have a few real brains which they know how to use when they have a chance. Then too I've cut out all gum-shoe work in the taking of time studies. But that's part of another story, as Kipling says.

"First thing I did was to try and put myself back in the old shop as a worker, and then out here in mine, and see what the difference was. Well, Godfrey, old man, it startled me. Back there we knew what was going on in the whole works. When the old man got that order for the engines for the ferry boat we were as tickled as though it was ours. He'd talked it over with us and together we'd planned out how we'd have the cylinders in the big lathe by blocking up the head and tail stocks. We'd plane the pedestals by mounting a head on the planer table and bolting the work to the floor, and we had more nifty little kinks than you can think of. Interested—say it was a liberal education for all of us and we knew it.

"But what happens out here. Lathe hand No. 17-21 draws a pink slip with a blueprint that tells him to turn 24 special studs. Tells him what tools to use, how to chuck it and dog it, and how many times to wink his left eye during the process.

"Does it tell him that these studs are to be used on that special ore crusher for South Africa and that much depends on their being done on time? It does not. It assumes it isn't any of his durned business and that he hasn't brains enough to know where South Africa is anyhow.

"Is he interested in his job? He is not, and neither would you or I be. We've 'pink slipped' the interest out of the job, old man, and by heck we've got to put it back.

"We can't go back to the old days for several reasons. We haven't the same kind of men, because we haven't trained 'em, and we haven't the time. But your Uncle Johnson has got several bees a-buzzing in his bonnet and when the hive is ready to swarm I'll send you a special invite. I am going to get back some of that old shop feeling if it takes a leg; I'm going to keep on putting myself in the other fellow's shoes until I find the answer. And if I can keep the dodgasted directors quiet till I get it swinging, I'll show 'em what production really is."

If Johnson can really see things from the viewpoint of his men, he's getting on the right track.

Use and Abuse of the "Belt Stick"

By R. B. Frank

The belt stick is a very useful article of furniture in the average machine shop in which there are always two or three—or more—according to the size of the shop.

They are made by the simple expedient of taking a narrow board from 6 to 8 ft. long, whittling down one end for a handle and putting a stud through near the other end, the stud projecting 5 or 6 in. and held by a couple of nuts so placed as to allow the board to be clamped between them. A hole 1 in. or so in diameter near the stud allows the stick to be hung upon a nail in a convenient place.

Certain places are assigned in which these sticks are to hang so that when one is needed in an emergency (it is always an emergency when one is needed), all that is necessary to get it is for the frantic machinist who needs it to rush to the place where one ought to be, find that it isn't there, and yell, "Boy! where'n blazes 'is that dambeltstick?"

Considerable time in the aggregate may be lost by this method, especially when, as is not infrequently the case, the boy also is misplaced, so the best method is to hang them up back of the upper cone of the lathe countershafts.

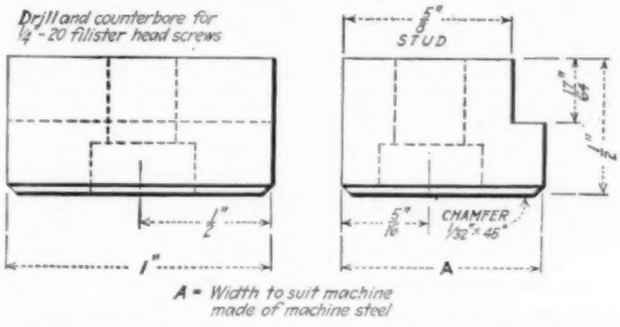
They are used, probably more frequently than for any other purpose, for running a tight belt into the upper step of the cone when it is necessary to speed the lathe for polishing or filing. If they are hung back of the cone with the stud pointing forward the belt can be run up easily by grasping the stick and giving it a twist.

If needed for other purposes it is quite as likely to be found here as it would be in any other place.

Standard Tongue for Milling Fixtures

By C. H. Dengler

Many times it is desirable to use a milling fixture on more than one machine, and when the width of the slot in the tables is different trouble ensues. The usual way of milling the slot in the fixture the same width as



ADAPTING A FIXTURE TO DIFFERENT MACHINES

that in the machine and making a tongue to fit both, prevents interchangeability.

A good way to avoid this trouble is shown in the drawing. The slots in all fixtures are made ⅝ in. wide and, by making the key of tongue as shown, may be used on any machine desired by choosing the required width of tongue.

Radius Link Designing

By Arthur R. Melloy

In turning the radius on a shell point by using a link to guide the cross-slide, several governing factors should be known:

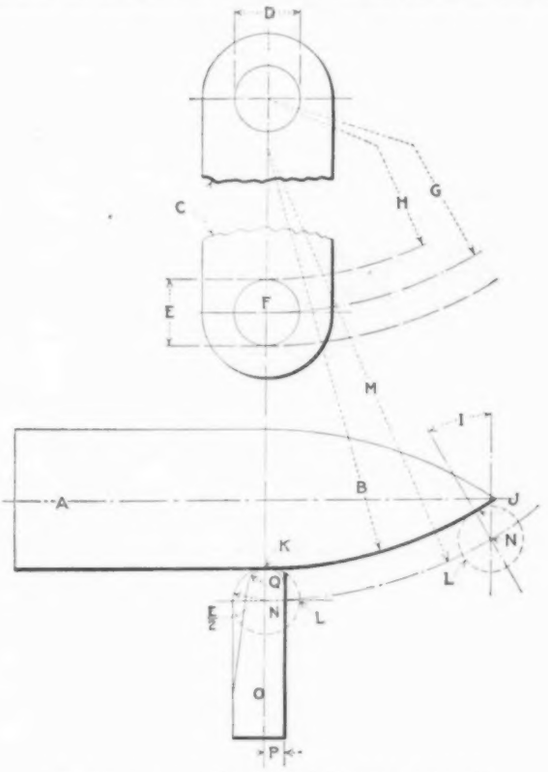
1. The center-to-center distance of the link should be the length of the radius to be cut on the shell plus the radius of the pin hole in the link end which controls the cross-slide.

2. The finishing tool must be ground to the same radius as the radius of the pin hole which connects the link end to the cross-slide.

3. A roughing tool may be used having a smaller radius than the finishing tool providing it bears a proper definite relation to the finishing tool.

In the figure let it be desired to cut a shell A of radius B using link C. Hole D has no bearing in the problem and for convenience may be made the same diameter as hole E which has a great deal to do with the final shape of the shell. The center F of hole E travels in an arc of a circle of radius G. H is the radius of the arc to which the inner part of hole E will run tangent when F travels the arc of radius G. For the present consider L as a roller of a diameter equal to the diameter E of the hole in the link and touching a finished shell at a point K.

As the roller travels along the shell, the point of contact K travels through an angle I to a point J. The center N of the roller travels the arc N-N of a circle of radius M. The point N is operated by the point F by means of the cross-slide and can only travel parallel to it and cannot pivot around it. Therefore if N and F travel in parallel arcs of circles, the radii of the cir-



RADIUS LINK SHELL-TURNING LAYOUT

cles must be equal; M is equal to G, and H is equal to B If any shape other than a circle is used in place of L, it is apparent that it would not be tangent to the finished shell at all points. Consequently the cutting edge of the finishing tool O must be the arc of a circle of radius $\frac{1}{2}E$. The length of radius G is equal to M because of the parallel motions, and M is equal to $B + \frac{1}{2}N$ or $B + \frac{1}{2}E$; therefore the center to center distance of the radius link must be equal to the radius of the shell plus the radius of the hole in the link end which operates the cross-slide.

If it is desired to use a roughing tool with a radius less than the radius of the finishing tool this may be done by establishing a size *P* for both roughing and finishing tools and then grinding the roughing tool to a smaller radius *Q*, remembering that by reducing the radius you leave a correspondingly larger amount of metal on the shell nose.

If the tools are designed as directed and a toolpost is used against the side of which the tools are lined up positively, the roughing and finishing tools may be interchanged indiscriminately without any fear of spoiling the work.

An Unusual Turning Operation

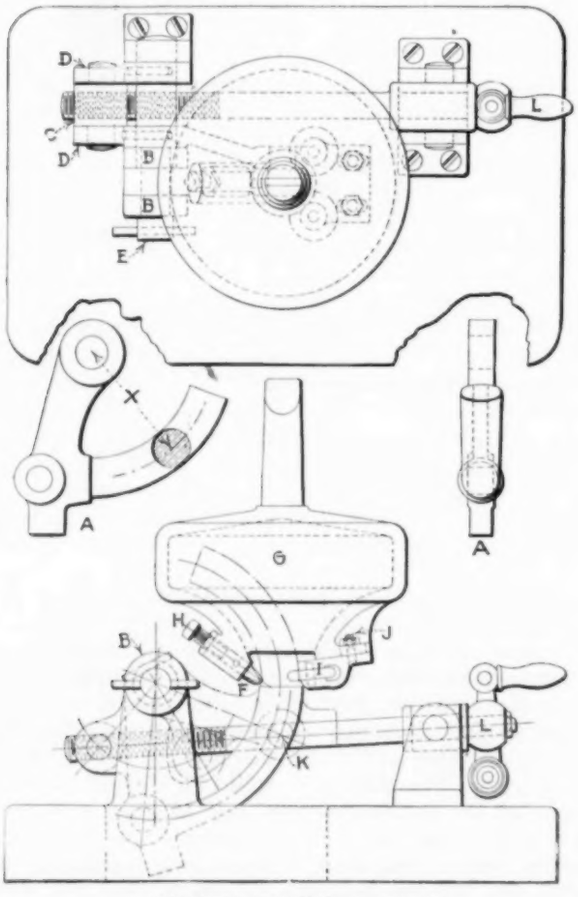
By Joseph N. Germain

At *A* in the drawing is shown a piece that we had contracted to furnish to a textile company. The arc, whose radius is *X*, has the large hole for a pivotal point. The tolerances allowed were as follows: ± 0.002 in. for the radius, and ± 0.001 in. for the distance between holes.

We made a simple pair of vise jaws to hold the pieces in the milling-machine vise so that the grip was upon the arc with the two bosses in the clear above the vise jaws. A straddle mill completed this operation.

The turning of the arc was a little more difficult, so we made up the device shown. It consists of a rectangular base on which are cast the two uprights *B*. The space between is the width of the large boss plus 0.002.

The nut *C* is made with trunnions turning in the double crank *D* which is rigidly held to the shaft by taper pins. The shaft is recessed where it enters the inner one of the uprights *B* to receive plug *E*. The cutting tool *F* is carried by the malleable casting *G* and is held in place by a setscrew. Adjustment of the tool is obtained by means of the screw and locknut *H*. The work is supported during the cut by the steadyrest *I* which consists of a pair of rollers and is adjustable by means of the screw *J*.



A UNIQUE TURNING DEVICE

To insert the work the cutter-head is raised above the highest point occupied by the work. The carrying lever is swung to bring the pin *K* to this point and the smaller hole in the work is put on *K* and the work rotated until the larger hole is in line with the holes in the uprights *B*. The pin *E* is then pushed into place. The work is swung back by turning the handle *L* until the pin *K* assumes the position shown in the figure.

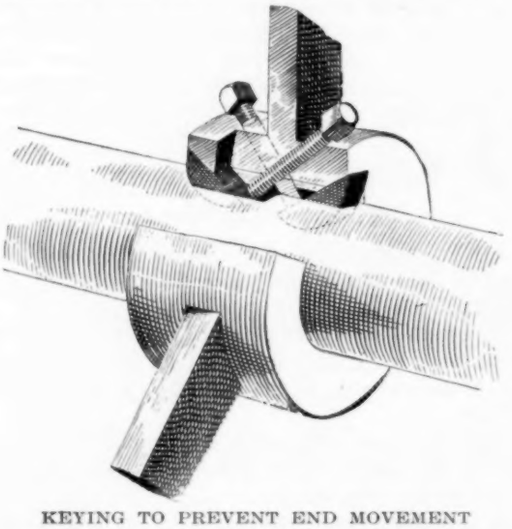
The cutter-head is then brought down to a point where the cutting edge of tool will be in the same horizontal plane with the center line of the pin *E* and at a distance from the center of the latter equal to the radius *X*. A stop collar on the spindle of the machine is adjusted so that the cutter-head will always be brought to the same point each time after it has been raised. The base is fastened to the table of the drilling machine.

We found it economical to handle the work twice, taking a roughing cut over all the pieces at the first setting, leaving about 0.008 in. to 0.010 in. for the finishing cut.

Keying a Hub Against Endwise Pressure

By P. G. Tismer

In making repairs to the clutch mechanism of some concrete hoists, it became necessary to key the hub of the clutch spider to the shaft in such a way as to prevent it from moving out of position endwise. This object had been secured in the original construction by pinning it to the shaft. The repairs were made necessary by the fact that the clutches would not hold in hoisting the load, and the changes involved the toggle joints in the clutch levers to secure greater power transmission through the clutch without slippage. Shortly after putting the new gear into service, the pins before mentioned began to shear off, and to stop this trouble the writer devised the method of holding that is shown in the sketch herewith.



KEYING TO PREVENT END MOVEMENT

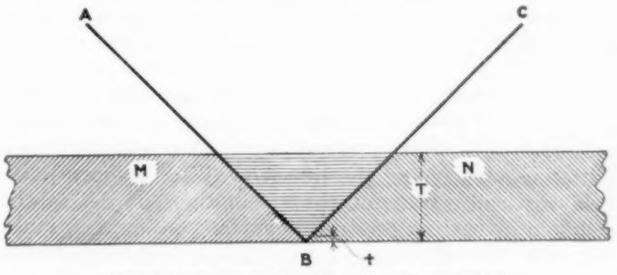
Two keyways were cut in the bore, their ends being cut out diagonally across the corner, one at each end as the sketch shows, and two Woodruff keys were sunk in the shaft. Setscrews set cornerwise in the hub bear upon the inner ends of the keys, holding them snugly in an angular position that effectively prevents the end movement of the hub. If it is feasible to put a setscrew in at right angles to the shaft, then only one keyway is needed, as one setscrew may bear upon the inner ends of both keys.

Maximum Thickness of Material Welded With Gas Torch or Electric Arc

By R. L. Browne

From a scientific point of view there is obviously a limit to the thickness of material that can be welded by a method of gradually building up without leaving strains in the body of the metal comprising the weld.

In making a weld in this manner the parts (*M* and *N*) to be united are V'd out (*ABC*) as shown in the



BUILT-UP WELD OF FLAT PLATES

figure, the included angle being about 90 deg. The weld is built up drop by drop and layer by layer, beginning at the bottom *B*.

As the thickness *T* ($T = \Sigma t$) of the weld increases, the rigidity of the welded zone, measured by the force *R* opposing a bending action, increases. Hence:

$$R \propto T$$

A constant force of contraction *S*, due to the natural shrinkage of each layer of metal comprising the weld as it is applied, is continuously exerted directly across the weld between *M* and *N*, tending to pull these parts toward each other and thereby warp or bend the welded zone. In fact this warping actually occurs from the starting of the welding operation and continues in a diminishing degree during the time that the relation $S > R$ maintains. This distortion relieves the shrinkage strains in the metal constituting the weld, thereby permitting a union to be made, which from an engineering standpoint is satisfactory.

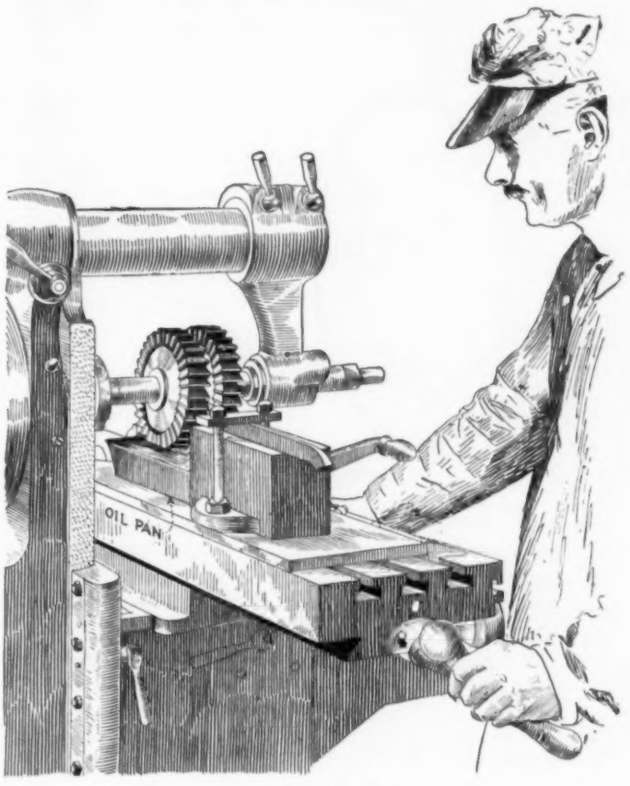
Inasmuch as the value of *S* remains constant for each added layer of metal throughout the entire welding operation, and *R*, which is a function of *T*, continues to increase with *T*, there is a transition point where the relation $S > R$ changes to $R > S$. From this point on, the force *R* resisting the shrinkage of metal added to the weld is greater than the force of contraction due to this shrinkage and the natural shrinkage of the metal is prevented. Strains are consequently established in the metal comprising the weld, which from an engineering standpoint is in an unstable condition, and a weld built up in this manner should not be attempted.

In other words, the maximum thickness *T*, which should be welded by a gradually built-up process is determined by the mathematical value corresponding to the change in relationship of $S > R$ to $R > S$, bearing in mind that *R* is a function of *T*. It is evident that this value will vary with different materials.

A Kink in Cutter Lubrication

By Adolph Moses

While passing through the shop I noticed this little cutter-lubricating kink. The work is strapped to a block bolted to the milling machine table which is fed



OILING A CUTTER

longitudinally to the cutter. A pan partly filled with oil is placed beneath the cutter and the latter, dipping into the oil, gets a good supply of it without wasting any. This was done on one of the old-style machines that had no pump and proved to be far more satisfactory than letting oil drip from a can.

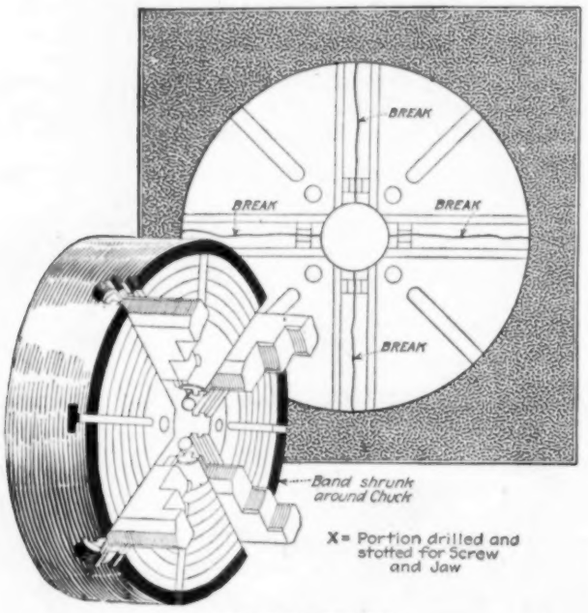
Repairing a Broken Lathe Chuck

By A. H. Yoch

A four-jawed chuck belonging to one of our heavy lathes had been broken into four pieces by the accidental movement of the lathe carriage, the break being along the jaw channels so that the chuck was practically separated into quarters. It was a most complete wreck and seemed impossible to repair, as to weld the parts together and then re-machine the chuck, as would be necessary to make the jaws fit and restore its accuracy, would cost more than a new one and would take a longer time than the chuck could be spared.

Because of the urgent need for the chuck, the following described method of repair was attempted, and somewhat to our surprise the result was very satisfactory, the repaired chuck being as good as new and

not even having the appearance of a repair job. The edges of the breaks were carefully cleaned of loose particles of metal and the parts brought together with the chuck lying face downward on a bench plate. A steel band of suitable size was made by bending and welding a piece of bar steel into a ring leaving the



A REPAIRED CHUCK

inside diameter small enough to finish. This band was then bored to a shrink fit over the outside of the chuck and shrunk into place. Then putting the chuck onto the lathe the band was turned and faced. Boring the holes for the wrench and slotting the band to allow the jaws to enter their channels completed the job and made the chuck practically as good as new.

Scaling Reduced Drawings

By B. A. Tyson

In making careful studies of line cuts of machine drawings in technical publications it frequently happens that many of the desired dimensions are not given and it usually always happens that the scale of reduction is such that none of the customary graduations on the draftsman's scale will fit. Usually one or more dimensions are given or may be learned from the description accompanying the cut. From one of these the ratio of reduction may be determined. By measuring with a full size scale and applying this ratio, the other dimensions may be computed.

For a complicated drawing this procedure involves considerable arithmetic or slide-rule work. For accurate and rapid work a scale may be made to fit the cut. This may be done in 15 minutes by the following application of the familiar method of dividing a line into a given number of parts.

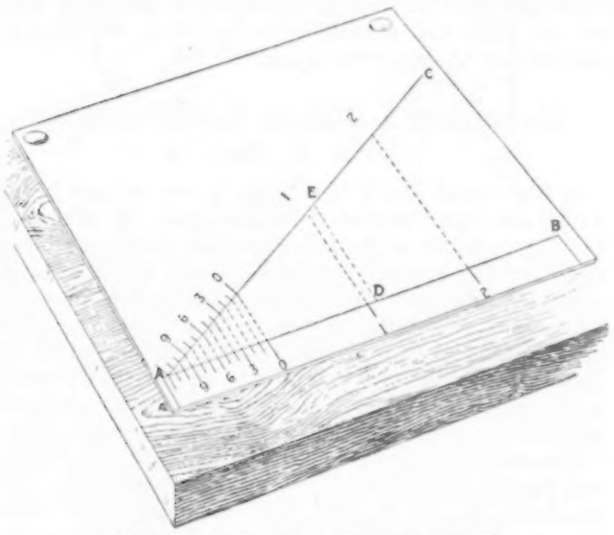
Select on the cut one of the known dimensions, a long one if possible, and, as shown in accompanying sketch, lay off an equal distance *AD* on the line *AB*. Suppose this line represents 26 in. on the cut. From *A* draw *AC*, making any angle—say 30 degrees—with *AB*. Now lay off on *AC* the distance *AE* equal to 26 in., selecting the scale which will bring *E* as nearly as possible directly over *D*. Draw *ED*. Beginning at *A*, lay off on *AC* the graduations of the scale used in laying off *AE* as indicated, and project on *AB* the joints marked off by drawing lines parallel to *ED*. Now with a knife and straight edge, cut along line *AB* and the scale is complete.

If permanency is desired, a very presentable and durable article may be made by using a piece of thin white celluloid. Cut a strip about ½ in. wide and pin down with one edge facing the line *AB*. With a sharp knife held vertically, transfer the graduations of *AB* to the celluloid by cutting lines in its surface. Next rub india ink over the surface of the strip. By washing off the excess ink, each scratch made by the knife will retain the ink and will show up as a sharp black line. This home-made scale will compare favorably with one that costs real money.

Eraser for Pencil Marks

By J. H. Moore

Instead of using an eraser to take out fine detail on pencil drawings I use a fountain-pen filler with a piece of cloth wrapped around the small end. The tube is filled with benzine, and when picking it up a slight pressure on the bulb moistens the cloth so that pencil marks may be wiped out with it without smudging adjacent lines.



AN EASILY MADE REDUCING SCALE

ERASER FOR DRAFTSMEN'S USE

Gun-Boring Tools and Data

By FRED H. COLVIN
Principal Associate Editor *American Machinist*

The drilling of deep holes has been a difficult problem in many places. This article shows the tools and practice of one of the most successful gun shops, and the same facts are equally useful in any other kind of deep drilling and boring.

ONE of the things we have learned from the war is the art of deep boring, and the experience gained in this line can be utilized in other kinds of work. One of the shops which was most successful was the Tioga Steel and Iron Co., of which L. R. Layton is mechanical superintendent, their new gun plant in Philadelphia having made a splendid record in handling 4-in. guns for the navy. An outline drawing of this gun, with only a few main dimensions shown so as to give an idea of the work involved, is illustrated in Figs. 1 and 2, the first showing the jacket and the second the gun tube or liner.

As is usual in all work of this kind test pieces are cut from each end of the forging, these disks being sawed so as to give two bars from each disk, the ends of these bars squared and the bars turned to a standard section for the testing machine. This work took 4 hours, this being divided into 1 hour for cutting the disks from the forging, 1 hour and 15 min. for hacksawing the four bars and squaring the ends, and 1 hour and 45 min. for completely turning the four test pieces. This refers to the tube forging.

The disks from the ends of the jacket forgings were cut on a double-bladed Newton cold saw instead of in the lathe, as was the case with the tube, and the time was somewhat less in spite of the increased diameter of the forging. Test pieces were also made from these, as in the case of the tube.

The average weight of the jackets shown in Fig. 1 was 11,490 lb., this being reduced to 10,900 lb. after the end had been removed for making the test pieces.

After the jackets were rough-turned and bored the average weight was 5114 lb., which shows that something over 2½ tons of metal was removed in these operations. It is interesting to note that it was unnecessary to make a special operation of removing scale before machining the gun, as heavy scale was not allowed to accumulate during the forging operation, and the light scale was loosened by green annealing. This also applied to the gun tube. Before any machine work was done, the forging was carefully examined to find the extent of all defects before laying out and centering for rough-turning. These defects were examined with the aid of a chipping hammer or, in the case of seams, drilling at various points along the seam with a portable electrical drilling machine, using a ⅜ to ½ in. diameter drill.

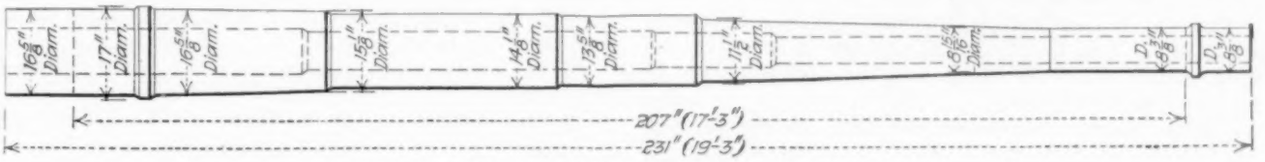


FIG. 1. JACKET OF 4-IN. GUN

Both the turning and boring were done on Bridgeford 36-in. heavy pattern lathes, the time required for turning being 11 hours, using two tools at a cutting speed of 31 ft. per minute. The depth of cut was $\frac{9}{16}$ in. and the feed per revolution 0.131, removing 210 lb. of metal per hour. The boring of the jacket was divided into four operations, these requiring 14 hours to complete. The feeds for these operations were as follows: Operation 1, 0.3 in.; operation 2, 0.6 in.; operation 3, 0.48 in., and operation 4, 0.4 in. The weight of metal removed was 170 lb. per hour, and the type of boring head is that shown in Fig. 3.

This boring bar has a number of very interesting details, three views of the body being shown at *A*. Four hard-steel wearing strips are provided, details of

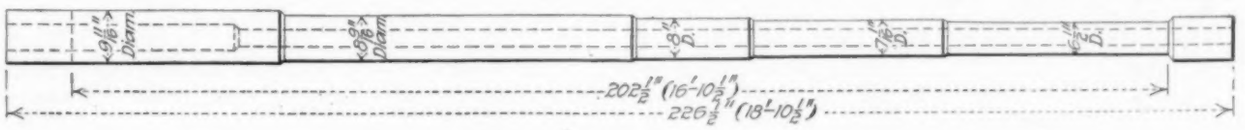


FIG. 2. TUBE OF 4-IN. GUN

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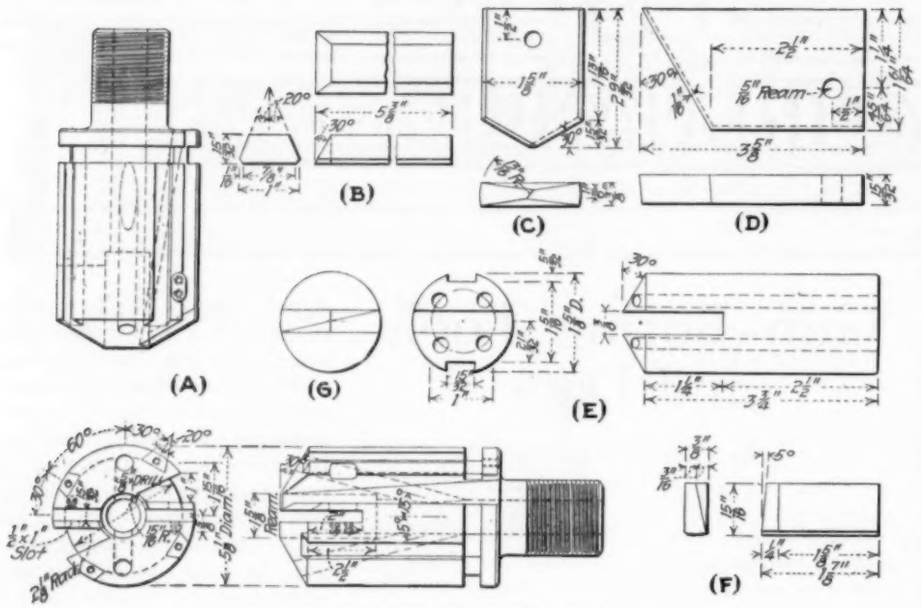


FIG. 3. BORING HEAD FOR JACKET

this being shown at *B*. One form of pilot drill is shown at *C* and another at *F*. The first is a single solid cutter while the second is in two parts, put together as at *G*, and held in the holder *E*. This holder has four holes for lubricant, these holes communicating with the central chamber in the body of the boring head. It will also be noted that there is a $\frac{1}{32}$-in. slot on each side of the pilot drill holder. These fit the cutters on each side of the boring head and effectively prevent turning in the head itself.

The flat boring cutters for the head are shown in detail at *D*, the lip clearance and the location of the chip-breaking notches being left for determination in the shop, which is a very sensible thing to do. In order to utilize worn cutters provision is made for turning back the front face of the boring head after there has been an accumulation of worn boring cutters.

A very similar type of boring bar was used in the tube, but owing to its being of somewhat smaller diameter it presented different problems of construction, and is on this account shown in detail in Fig. 4. The head or body is shown at *A*, two cross-sections showing the holes for the lubricant being shown at *B*, the hardened wearing strips at *C* and the main cutters at *D*. At *E* are shown both the two-part pilot drill and the holder, these being very similar to those shown in Fig. 3. In view of the difference in diameter, however, it seems best to give considerable detail to the dimensions, which may well form a guide for anyone with deep boring to do. The illustrations show the details so clearly that further description is unnecessary.

The cutting lubricant for the sawing and for the gun boring was made of a 30 per cent. soluble oil mixed with 15 to 20 parts of water. but it should be understood that this performance could not be counted on as a regular thing.

Some Excellent Records

The following records on boring have been made:

5000 ft. of guns bored in July with 3 lb. 13 oz. broken drill blades.

6000 ft. of gun bored in August with 3 lb. 4 oz. broken drill blades.

48 ft. continuous cutting with $3\frac{5}{16}$ drill without grinding.

42 ft. continuous cutting with $5\frac{3}{16}$ drill without grinding.

39 ft. continuous cutting with $7\frac{1}{4}$ drill without grinding.

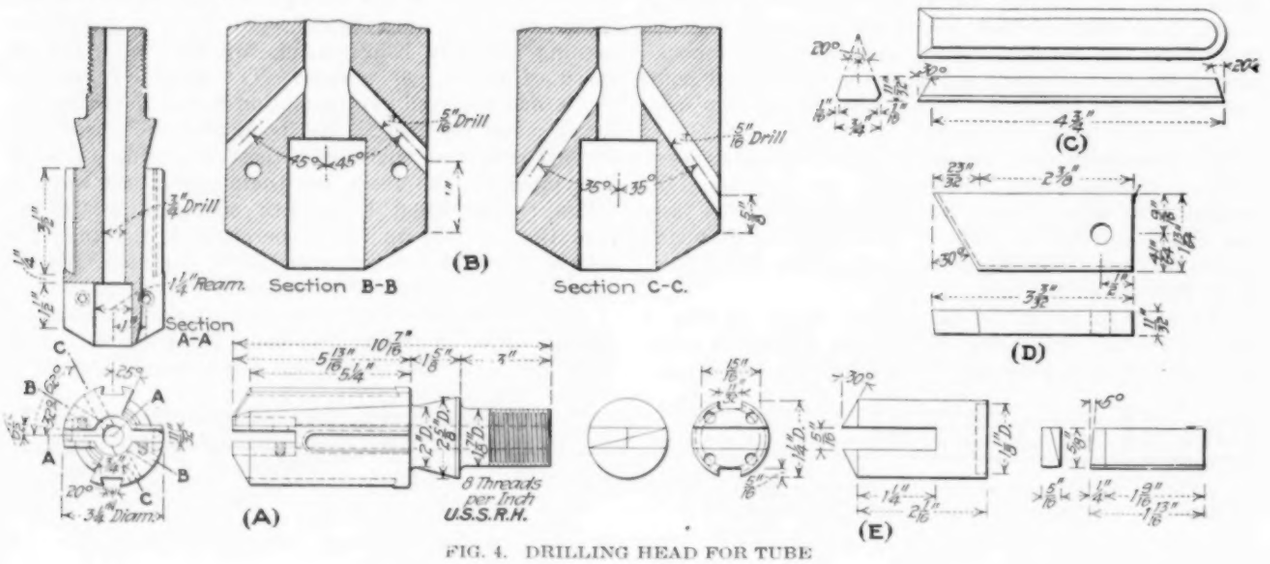


FIG. 4. DRILLING HEAD FOR TUBE

ARMY ORDNANCE NEWS

They have also made speed records on boring as follows:

53 in. per hour with $3\frac{5}{16}$ drill.
48 in. per hour with $5\frac{3}{16}$ drill.
36 in. per hour with $7\frac{1}{4}$ drill.

These speed records cannot be maintained without increasing the breakage and the frequency of grinding cutters. As far as the experience of this shop shows in this line of work the speeds covered in the body of this article are the most efficient from all standpoints.

The work on the gun tubes is also interesting, the tubes being over 18 ft. long in the rough and weighing 4378 lb. After removing the test pieces the weight is 4110 lb., and when rough-turned and bored, 2223 lb.

PERSONALS

Maj. John M. Parker, who has been Chief of the Military Guard Section, has been discharged. His home is at Owego, N. Y. He attended Cornell University and studied mechanical engineering. He is also a member of the New York bar.

* * *

First Lieut. P. H. Taylor, who is an electrical engineer and a graduate of Lafayette College, has been discharged from service. His home is at South Germantown, Penn. He has been on duty at the Aberdeen Proving Ground as a proof officer.

* * *

First Lieut. Richard C. Eggleston, 5035 Florence Ave., West Philadelphia, Penn., has been dismissed from service. He is a graduate of Yale and was formerly employed by the Pennsylvania Railroad Co. and in the service he has been on duty in the Planning Section of the Engineering Division.

* * *

Maj. Frank W. Wood of Cleveland, Ohio, president of the Wood & Spencer Co., machinists and machinery manufacturers and also president of the Cleveland Castings Pattern Co., has been recently discharged from the service. He served about eleven months in France in the Construction and Maintenance Division.

Pliny Holt Perfecting New Cannon Carriage

Pliny E. Holt, of the Holt Manufacturing Co., and recently in charge of the corps of engineers engaged in the development work of artillery tractors for the Ordnance Department, has, since leaving the Government employ, been working upon new problems in gun motorization. Mr. Holt, who was born in Loudon, N. H., became an Ohioan at the age of six and a resident of Minnesota at the age of ten, inheriting at an early age his taste for travel which takes him from the Stockton plant of the Holt company in California to the Peoria plant of the company and to Washington at frequent intervals. He is a graduate of the University of Minnesota and paid his college expenses by conducting an electrical repair shop in the afternoons, attending classes in the forenoon.

His connection with the Holt Manufacturing Co. dates from Feb. 15, 1896. Since then until he resigned to accept a position as expert for the Government during the war, Mr. Holt's experience has covered all branches of tractor work. To him more than to any other

PLINY E. HOLT

man belongs the credit for the successful development of the "Caterpillar." He organized the Aurora Engine Co., at Stockton, in 1905. In 1909, Mr. Holt moved East, bought the Colean plant at Peoria and organized the Holt Caterpillar Co.

In 1913, he was made vice president and general manager of the consolidated companies, including the Holt Manufacturing Co., Holt Caterpillar Co., Houser & Haines Manufacturing Co., the Best Manufacturing Co. and the Aurora Engine Co.

During the time that Mr. Holt was in Washington he not only supervised the design and building of the pilot vehicles which were afterward called the 10-ton, 5-ton and $2\frac{1}{2}$-ton artillery tractors, but in addition to this he made the preliminary study of the one-man tank which was later built by the Ford company. He also supervised the work of preliminary design of the 150-ton tank and started work on the 1500-ton tank at the request of the Naval Consulting Board, which work was finally completed in conjunction with the engineers of the Westinghouse company. On Aug. 3, 1918, Mr. Holt was appointed by General Williams as chairman of the board organized to handle the production of the caterpillar-artillery program.

Freight Forwarding for Export*

By W. J. RILEY
Export Manager, Judson Freight Forwarding Co.

The forwarding of export freight has many complex problems, the solving of which the exporter is glad to be relieved. This article tells in detail what must be done in forwarding export freight and sets forth the duties of the forwarder. The forwarder must know specifically what can and cannot be exported from this country and imported into other countries. He must be familiar with and think in terms of permits, licenses, declarations, banking requirements, collection facilities, insurance, risks of war, loss, damag, theft, customs regulations at home and abroad, the most favorable routes by land and water, etc. His services are as valuable to the exporter as are the services of the custom-house broker to the importer.

THE freight-forwarding business is divided into several classes. Some forwarders confine their efforts to domestic business, and some even to certain commodities within limited territories. Some forwarding companies extend their activities to cover all branches of both foreign and domestic business. The subject to be considered on this occasion is the forwarding business in connection with foreign trade only.

Briefly, then, a freight forwarder is one who is able to handle in every detail any kind of a shipment from any point in this country to any point in any other country which can be reached by any form of recognized transportation.

A forwarder is in business because the requirements of business have created him. His services are sought for the same reason which impels a man to hire a plumber when he has a leaky faucet, or to employ a doctor when he is sick. The point is that the forwarder is a specialist in his line, just as truly as any tradesman or professional man is a specialist in his vocation.

Knowledge Required

He must know, or be able to find out very quickly, what articles our Government will permit to be exported and what the governments of other countries will permit to be imported. If there are any restrictions he must know the character and extent of such limitations and how to overcome them.

He must know all about the permits, enses and declarations which are required and how to obtain them. He must have a thorough knowledge of all banking requirements and collection facilities in this country and other countries; he must be able to quote instantly approximate figures and quickly to quote actual figures of cost to handle a shipment of any commodity from point of origin to final destination, including all of the elements which form a part of that cost.

He must know all about the various kinds of insurance covering marine, war, theft, pilferage, loss, and damage, and be able to quote cost of coverage, against these risks.

He must know the customs regulations at home and abroad, as well as the most favorable trade routes at different seasons and under varying conditions, in order that the promptest, most economical, most satisfactory service may be secured not only for the consignor in this country, but for the consignee in a foreign country.

In short, a forwarding agent must know everything in connection with transporting a shipment which the shipper does not know, and which he cannot learn without incurring a greater expense than the cost of the forwarder's services.

Service To Be Rendered

Having stated what a forwarder must know, it follows that he must be able to translate his knowledge into service. Otherwise, his service, which is all that he has to sell, would be as useless as the wisdom of an astronomer in toting a hod of bricks.

He must make prompt, complete and courteous replies to all inquiries, and must anticipate the shipper's needs and provide him with shipping-instruction blanks to be filled out to meet all possible emergencies.

He should be able to immediately place insurance with any insurance company named by the shipper, or to arrange for such insurance under a blanket policy which every up-to-date forwarder provides for immediate use. He must maintain his own warehouse or have warehouse connections to take care of goods at assembling points and at ports of exit pending shipment. He must make all arrangements to comply with custom house and consular requirements.

The forwarder must secure and book steamship space for each individual shipment; and in many cases, he must contract such space in advance for the protection of, and in anticipation of, the needs of his patrons.

He must maintain offices manned by experts who are capable of attending to every detail in connection with clearing shipments from port of exit. In many cases, this involves the work of locating cars in railroad yards and shipments in freight houses and warehouses, and in seeing that they are moved at the proper time to the docks, and cleared on the steamer for which booked.

He must not only maintain offices in United States ports of exit, but he must have agents or representatives in the principal ports and cities of all foreign countries. He must have banking credit and facilities for discounting drafts when required and for making collections at foreign destinations.

In order to take care of the prepayments of rail and ocean charges which are demanded by railroads and steamships pending reimbursements on the part of the shipper, the forwarding agent must have a considerable amount of invested capital.

As the methods of handling shipments via the Pacific differ somewhat from the methods via the Atlantic and Gulf Ports, it may be well to describe these conditions briefly and separately.

Consignments to Australasia or the Orient are, with few exceptions, handled on through bills of lading, covering rail and ocean movement from point of origin to final destination.

To enjoy the proportional rail export rate and other

*From an address before the Sixth National Foreign-Trade Convention, Chicago, Apr. 25, 1919.

benefits of these through bills of lading, it is necessary that every consignment shall be contracted for and booked in advance with a steamship line.

A rail permit must be obtained and the shipment must then be made within the limits prescribed by railroad regulations: namely from 25 to 30 days from Chicago territory, and from 30 to 35 days from eastern territories prior to the scheduled sailing of the steamer on which shipment is booked. The permit number must be shown on the initial line of the bill of lading.

These through export bills of lading are not, as might naturally be expected, made up by the railroads, but are made up by the forwarder at his own expense. The railroad company furnishes the blanks; the forwarder fills them out in every detail including shipping permit numbers, order numbers, descriptive markings, and every item and condition necessary to make a complete document. On nearly all trans-Pacific shipments, it is necessary for the forwarder to make up from 20 to 25 copies of each lading. The shipper usually requires two or three originals and several non-negotiable copies for his own use; the other copies are required by the railroad and steamship companies and also for the use of the forwarding agents at port of exit and for custom-house purposes, etc.

Bills of Lading

As soon as possible after the shipment moves from point of origin, copies of the bills of lading and full instructions as to steamship bookings are mailed to the agent of the forwarding company at port of exit, who then takes care of custom-house requirements, checks up the shipments to see that they are brought down to the docks and placed on the boat. The forwarder's agent at port of exit then advises the home office of particulars of clearances, which are, in turn, communicated to the shipper.

As is generally known, railroad companies do not issue through bills of lading covering export shipments via Atlantic Coast ports. The rail movements and the ocean movements are handled separately. On less than carload lots, it is not absolutely necessary to make advance steamship bookings although it is desirable to have these bookings made whenever this is practicable. These LCL shipments must, of course, be warehoused between the time of arrival at New York and departure of steamer.

Carload lots require the issuance in advance of a G. O. C. (General Operating Committee) permit, which permit is not issued until after a firm booking has been made with steamship company and evidence submitted that this has been done. This permit specifies the dates within which the shipment must be made. Notice of arrival of cars is furnished to the forwarder's agent at the port, who arranges for prompt transfer to the loading dock.

The steamship companies furnish blank bills of lading to the forwarder, who makes up, at his own expense, all the necessary copies to comply with the requirements of the shipper, the banks, the steamship companies, customs house, etc. This entails issuance of from 15 to 20 copies of each steamship lading. The forwarder's agent at port of exit sees that all the papers controlling or concerning the shipment are mailed on the boat which carries the freight or on some fast mail steamer which will reach the consignee as early or earlier than the goods will arrive at destination.

The forwarder's agent at the port advises the home office of clearances, which are in turn communicated to the shippers.

Shipments via Gulf ports are handled practically in the same way as via the Atlantic. It might be stated at this point that the question of having railroads issue through bills of lading from point of origin to destination via Atlantic and Gulf ports is now having serious consideration. The consensus of opinion is that arrangements for such through bills of lading will be made in the near future.

Having now outlined the duties and service of the forwarders under normal conditions, it might be appropriate to refer to conditions which existed during the war. There were, of course, many disappointments to shippers, some of which may have been attributed to the forwarders, whereas, the latter, like the shippers themselves, were simply the victims of war conditions.

War Conditions

For instance. The Railroad Administration provided time limits and rules governing shipments from interior points to the ports. The shipper may have complied with these requirements. His shipments may have reached the port in time for the scheduled sailing, but the consignment may have been shut out on account of steamer having over-booked its capacity, or the sailing of the steamer may have been cancelled, or the Government may have, at the last moment, commandeered a large portion or the entire capacity of the steamer. In other cases, the shipments may have failed to reach the ports on account of congested conditions of the railroads particularly in the vicinity of the ports. These conditions were, in most cases, unavoidable and in many cases beyond the control of the forwarder. As a consequence, storage charges and demurrage charges accrued, for which it is frequently found impossible to obtain any redress. Upon reflection, it will be realized that the disappointments and the extra costs which the shippers may have been called upon in many instances to pay, were not due to failure on the part of the forwarders to do everything that possibly could be done, but was due entirely to the war conditions which are now ended. The services which have been rendered in the past by the forwarders may be accepted as an evidence of the assistance which they can render to the shipping public in the future.

It may not be generally known, but it is nevertheless a fact, that the principle of consolidated cars which enables the forwarder to make reduced rates on LCL shipments and to offer improved service in connection with handling the same, was finally approved and supported in a case which was taken up to the United States Supreme Court by three or four forwarding companies. At that time, a few of the railroad companies were opposed to the principle involved. It is only fair to say, however, that since that time the railroad companies generally have recognized the value to themselves of the consolidated car principle and may now be found to be favoring the forwarders as an adjunct to their business. A few months ago, an order was issued to discontinue the issuance of through bills of lading on export shipments via Pacific Coast, and the cancellation of all export-rail rates. This order was, of course, fought by shippers; and without in any way minimizing the efforts of the shippers, it may be truthfully asserted that the forwarders, by their united efforts and their knowledge of the business, were able to demonstrate the evil effects of the proposed order to

the Railroad Administration so promptly and clearly that the Railroad Administration was led to cancel the order. Of course, the cancellation of the order to discontinue issuance of bills of lading carried with it the continuance of through export ladings, for if the original order had gone through, all export shipments would have had to move on local bills of lading and at local rates from point of origin to the ports. Another case is that of the demurrage tariffs at the ports, particularly on the Pacific Coast. The storage and demurrage charges assessed, worked a great injustice to the shipper who had complied in every way with the rules and regulations governing this traffic as laid down by the carriers. These matters have been greatly modified and the charges reduced, largely through the efforts of the forwarding companies in connection with the various boards who were in control.

The Forwarder's Value

The forwarder is not only necessary to the average shipper who wishes to engage in foreign trade, but his services are frequently employed by the larger concerns of the country who have their own export organizations to look after their own business, which is perhaps the best form of testimony which the forwarder can submit as to the value of the services which he can render. The reason for this is that the forwarder's connections and dealings are so wide and cover so many different fields of operation, bringing him into contact with cargo or so-called tramp steamships as well as with all of the regularly established lines, that he can frequently offer facilities to the big industrial companies which their own organizations do not cover.

The forwarder, through his agents and correspondents in foreign countries, is able to obtain particulars of manufactured articles and materials for which there is a market in foreign countries. These opportunities are submitted to the forwarder's customers, who are thus enabled to increase their business and frequently are placed in a position to open up an entirely new field for trade. Many merchants and manufacturers of this country have received their first foreign orders through the information originally furnished by the forwarders, and these orders were subsequently retained by the services of the forwarder.

Methods of Making Connecting-Rods

By Frank C. Hudson

The design of connecting-rods is much alike in all motors at present, the cap being held to the rod by two bolts as in marine-engine practice. A few still adhere to the cap with but one bolt and a hinge joint on the other side, but the four-bolt rod seems to have gone "by the board."

When it comes to the manufacturing methods, and I might say the principles involved, there is quite a difference of opinion. In most cases the rod is forged complete at the crankshaft end and the cap is afterward removed by sawing or milling. A few do, or did, forge the cap separately, face the surfaces on both rod and cap, drill for the bolts and after bolting them together, treat the piece as a solid rod in the boring and subsequent operations.

Some bore the holes in both ends of the rod, finish the holes with the proper center distance, then saw off the cap and use shims to replace the metal removed by the saw. Others, following airplane-motor practice, seat the cap and rod carefully together, without shims or liners of any kind, and finish the rod as though it were solid instead of having a removable cap.

The Spring of the Rod

Forgings vary a trifle in length and in other dimensions, and substantial boring fixtures are necessary to prevent the drill or boring tool from following the forged depression or hole as the case may be. The forgings are also apt to be a bit bent on cooling and some builders straighten the forgings quite carefully before the first operation. One difficulty is that, after the outer skin of the metal is removed in some places, the rod is very likely to spring in another direction. To help in avoiding this, one maker at least, subjects the straightened rod to a heavy pressure in what may be called a coining die, to help get it to the desired dimensions and to aid in holding the metal against further changes.

There is also quite a difference in practice regarding the machining of the holes in the rod. One well-known maker broaches both holes and fits the bearings shells directly to the broached surface. Others ream the holes, while still others believe that they should be carefully ground to secure the best results. The advantage of securing a firm and true seat for the bearing shell is of course admitted, but the method of finishing the hole does not of itself insure the holes being parallel. The motors with bearings cast directly into the rods avoid this difficulty.

Securing Alignment of Holes

It is customary to first finish the sides of the rod ends and work from these in securing holes parallel with each other. These surfaces are carefully preserved and in some cases rest on three-point bearings to insure squareness. But even this sometimes fails to insure the accuracy desired. The usual practice is to bore and ream or grind the large end of the rod first, as this gives a larger working surface for holding the rod.

One motor builder, who is very particular about the rods being parallel, has abandoned using the side of the large end in favor of the bore. He uses an expanding mandrel inside the crankpin end, after the hole has been carefully ground, and finds the results very satisfactory. The argument is that the bore presents a much larger working surface than the side and is therefore more reliable. Unfortunately all the methods seem to leave the necessity of a slight straightening of the rod at final inspection and it is something of a question as to how the steel behaves when it gets hot and is being hammered by the explosions at the rate of from 500 to 1000 times or more a minute.

The question of finishing connecting-rods all over seems to be solved in most cases by not doing it. One builder of high-grade cars finishes the rods all over as in airplane-motor work. Others building cars of equal grade do not attempt to finish the outside of the rods. All good builders select the rods for a given motor very carefully and allow but slight variations in weight whether they are rough or finished. There is a slight chance in favor of the finished rod changing less under the stress of service, but little trouble seems to develop in practice in either case. And it is practical results which tell us how valuable our theories are.

EDITORIAL

How Flexible Plans and "Know How" Made Rapid Production Possible

THE story of the Lincoln Motor Co.'s growth from a big idea to the actual building of Liberty motors at the rate of fifty a day in the short space of seventeen months, is well worth a little careful study on the part of every manager, designer and worker in mechanical lines.

In the first place the Osler idea goes into the discard because Henry M. Leland was seventy-four years old when the U. S. A. entered the war. The site of the plant was an open field, but both Henry M. and his son, Wilfred C. Leland, had the "know how"—dating back to the days before the automobile, when the machine-tool industry claimed them.

Two days after the company was incorporated it received an order for six thousand Liberty motors, the first to be awarded. The factory was yet to be built and the American Bridge Co. estimated from six to nine months' delivery for steel. A long-distance call found that steel was in process which could be used if plans were changed to fit the section of steel being rolled. In ten days the steel was being delivered at the factory site.

Machine tools had to be secured, and here personality played its part—the old connection in machine-tool lines helped to get the machines in record time. Eighty-five tool designers worked to equip the plant with over sixty-five hundred separate and distinct designs from which a total of over ninety thousand special tools were made. Many of these were due to the changes which were made in the motor itself.

At the end of a year the force had increased from one hundred to six thousand men and women, two thousand motors had been produced, and the rate of fifty a day had been attained. Contrast this with the plant of the best-known English maker with three years of aircraft-engine experience. With ten thousand employees the output was fifty motors a *week*.

There are several points in the success of this plant which have a direct bearing on the manufacturing of both the present and the future of this country. A man's capacity and not his age should determine his opportunities for service. Plans should be flexible enough to meet conditions, as shown by the change of shop plans to get steel quickly. A demand for exact sizes desired might have caused months of delay in getting the shop into operation.

The human factor in management helped greatly to secure the maximum output. The Lelands believe in helping men and women by giving them a sense of responsibility and teaching them to help themselves.

The output of the unnamed British aircraft motor company shows very clearly why it was not possible to adopt any of the foreign motors if we were to secure rapid production. Our Navy Department took this matter up very carefully and finally decided it was out of the question.

There were many unnecessary delays in getting an early production of motors due to the close tolerances demanded on non-essential dimensions, tolerances which were afterward greatly increased to allow production and with no detriment to the running quality of the motors. This, however, does not reflect on the builders but on the designers, who were supposed to be practical motor engineers. But in spite of these delays we were able to produce motors much more rapidly than any other country, which perhaps makes the delays more bearable.

There were other builders of Liberty motors who did excellent work both in production and in quality, but this was the only plant built exclusively for the purpose. The necessity of building a new plant, of equipping it and of securing mass production in seventeen months, makes it a most notable achievement and one full of inspiration for all red-blooded Americans.

Adapting Ideas to Our Own Needs

ADAPTABILITY is perhaps the most valuable asset of any mechanic, no matter what his position. The manager adapts plans and methods which have proved successful in other industries, to fit his own problems. The superintendent and foremen do the same, getting down to more detail in the use of specific machinery, tools and fixtures, and the machinist who can utilize his previous experience by adapting it to the new requirements, is of more value than the one who cannot change his work or his method.

The great value of the articles in the *American Machinist* and other publications is not that the tools and methods described will exactly fit the conditions in other shops but that they contain ideas and suggestions which can be adapted so as to be of value in a dozen classes of work. The principles involved, whether it be the method of locating or centering, of clamping or of machining, are all worthy of careful study. And unless this is done, the main value of the device may be easily overlooked.

If for example, it is found that the great majority of motor builders begin to machine their pistons by centering by the inside, it can be assumed that this method has been found most satisfactory for securing walls of equal thickness. This can then be accepted as a principle to be followed in all similar work, in work where it is necessary or desirable to have the inside of a casting concentric with the outside in the finished product.

In a similar way other fundamental principles of modern machine production can be determined and used to facilitate manufacture of various kinds. Without adaptability, the ability to modify and utilize ideas along similar lines, we lose much of the value of the experience of others. We can always keep tabs on our qualifications, however, by asking ourselves how we can adapt the ideas we see to our own work, and we should continually do so.

The National Machine Convenes at

THE semi-annual meeting of the National Machine Tool Builders' Association was held at Atlantic City, May 12 and 13. Some 300 members and guests convened at the headquarters at the Hotel Traymore, to consider and discuss after-the-war problems affecting the machine-tool building industry.

President A. E. Newton, in his opening address on Monday morning, May 12, called attention to the necessity of avoiding self delusion in the matter of costs. He stated that one of the principal lines of effort of the Association for the past several years has been to lead machine-tool builders to establish cost systems which would actually give accurate cost figures on the product. Mr. Newton pointed out the fact that there is usually a serious discrepancy between individual costs and the collective cost of doing business over a period of time; in other words, that the sum of the individual costs during, say a six months' period, seldom equals the total cost of doing business over that same period. Therefore the average manufacturer of machine tools or other machinery, unless he has a system of balancing individual costs against total periodical expenses, makes but 30 or 40 per cent. of his expected profits as shown by individual costs. He also pointed to the fact that a decreased volume of business, such as confronts the machine-tool industry, must inevitably increase costs by increasing overhead expense. These matters must be carefully considered by any manufacturer who contemplates a policy of price adjustment at the present time.

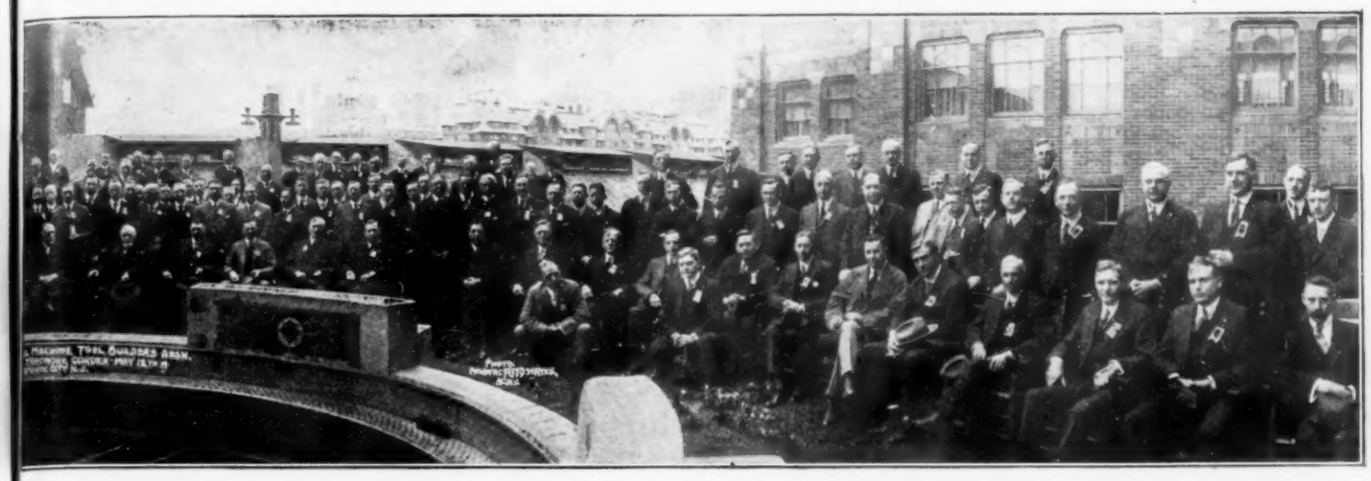
Howard W. Dunbar, of the Norton Co., reported to the Association the progress of work by the safety committee. He called attention to the proposal of the Bureau of Standards to constitute itself a source for the compilation of standardized safety codes, and to the alternate proposition to put this work under the control of the American Engineering Standardization Committee.

A most interesting and entertaining address was given by Mark Sullivan who told of his experiences at the Peace Conference and gave some food for thought as to the probable effect of the war on industry. Mr. Sullivan pointed out that first in importance is the loss of man power of the white race. Human beings are fundamental to wealth, and the existing number of capable human hands must inevitably influence the world's wealth. France has lost industrially, out of some 18 million males, a total of one and one-half million dead and an equal number permanently incapacitated from future efforts other than to merely take care of themselves. Other European countries have suffered in like proportion—the former Central Empires even more severely. One-third of the European industrial workers are permanently out of it. In addition to this present loss, the birth rate in France has fallen to one-half the pre-war standard, being now but 9 per 1000 per annum. He also pointed out, that at this rate, it would require an average length of life of 112 years per individual to maintain the present population of France. Great Britain has had a somewhat similar experience, for in 1918 for the first time the birth rate has been such as to be exceeded by the death rate. America, while it has not been so seriously affected by direct casualties, nevertheless, will suffer from this condition since Europe has normally furnished us with the necessary annual increment of crude labor. This has averaged one million immigrants per year. At a value equivalent to the nominal one of $1000 per individual this has meant a labor asset to the United States of a billion dollars per year, which we may consider as now totally withdrawn.

Mr. Sullivan called attention to the fact that due to the loss of man power and the declining birth rate, the full effect of the world's wounds will not be apparent for 20 years. At that time, due to these causes the white males of 21 years of age will be approximately one-half the number that we could have expected if the world war had not occurred.

While disbelieving in the possibility of such an event as a struggle between the white and the yellow races, Mr. Sullivan pointed out the fact that if such a struggle should occur it would most probably be in 1939, at which time the white race will be possessed of its minimum fighting manhood, relatively to the yellow race.

Turning to the aspect of the material losses brought about by the war, the speaker said that everything of this nature in Europe can be characterized as being in "bad shape." No adequate repairs have been made in five years and the result is typified in the condition of the French rolling stock. On a pre-war basis France



Tool Builders' Association Atlantic City

maintained a total of 250,000 railway cars in operation; at present there are not more than 100,000, and judging from Mr. Sullivan's personal experience, every one of these 100,000 cars has flat wheels!

In Great Britain it normally required the construction of 90,000 buildings per year to keep even. Since building has been practically prohibited in that country for the past five years, the deficit today amounts to nearly half a million buildings.

Mr. Sullivan drew some interesting pictures of the Peace Conference and of the part that was taken in it by Americans. Our representatives were the first to discover the fact that it would be impossible to collect the total cost of the war from the defeated enemy, this cost amounting to over $100,000,000,000 and that the maximum as shown by inventory, that could be gotten from Germany, was some $28,000,000,000. This amount to be collected is very carefully and insistently designated as "reparation"—the word *indemnity* being tabooed as conflicting with one of the 14 points which prohibited "indemnities."

Americans, according to Mr. Sullivan, were the first to discover, through the American Army Intelligence Service, that there was real danger of Bolshevism in Germany, due to lack of food and employment. As a result, the blockade was partly lifted on food and certain raw materials.

Charles F. Lang, president of the Lakewood Engineering Co., urged that we realize that the world had undergone more and greater changes than ever before and that we must prepare for still different conditions. Pre-war standards and prices have gone never to return, and an era of unlimited competition is sure to result disastrously for all. We have learned how to coöperate during the war and the benefits of this must not be lost now or in the future.

Mr. Lang traced the growth of business from the small one-man shop, through the combinations which resulted in the Sherman law and pointed out the bad effects of that law. He urged such legislation as may be necessary to allow legitimate coöperation, on the ground that a return to unlimited competition means destruction or centralization of business in the hands of a few.

The automobile industry was cited as an excellent and practical example of stabilized prices. Every buyer had the assurance that, during a given period, the price would not be lowered. A similar plan would, be believed, stimulate buying in all industries. The world's shelves are empty and there is ample business ahead for all.

Mr. Lang also traced the labor problem, pointed out that unions for collective bargaining were made necessary by the selfish action of some employers during the days of cut-throat competition and expressed gratification at the coöperation which is being shown between capital and labor in many instances. The war has shown labor its power and by coöperation and education we must show how it should be used. The spirit of coöperation must be fostered and the closer the manufacturers can work with the labor organizations, the better for all. The time may even come when there may be a new organization to which both can belong.

In the matter of foreign trade, Mr. Lang also pointed out the need for the same kind of fair dealing if we are to continue friendly relations with all the world. All were urged to buy for present needs at prevailing prices, to cease waiting for decreases which were sure to be slight, and to aid in keeping business moving by showing faith in the future, which is sure to be justified if we put our shoulders to the business wheel.

Director Stratton of the U. S. Bureau of Standards made an address, illustrated with stereopticon slides, on the work of the United States Department of Commerce, particularly that phase of it which had to do with the activities of the Bureau with respect to machinery building. He was followed by Allen Walker of the Guaranty Trust Co., who spoke on "Combinations Under the Webb Act."

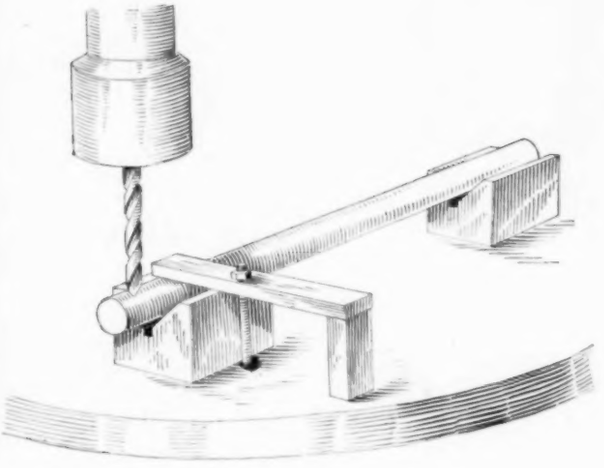
The convention appointed a committee, of which Stanley H. Bullard is chairman, to consider the question of acquainting not only the users of machine tools but the public at large, with the facts concerning the importance of the machine-tool industry as a factor in the maintenance and the advancement of the nation.

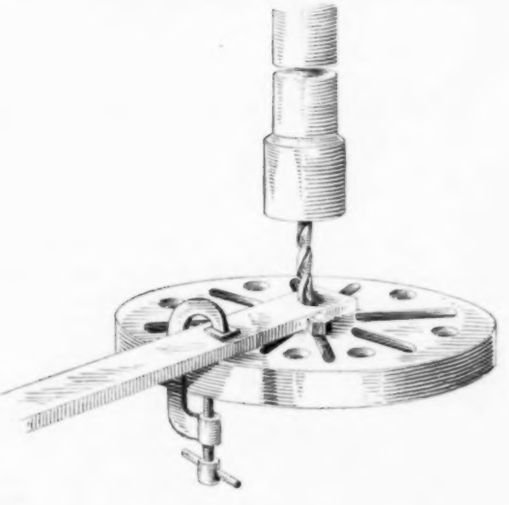
At the executive session of the Association, in addition to the resolutions of a routine nature, the following was adopted:

"Resolved that the National Association of Machine Tool Builders herewith expresses its disapproval of any or all attempts to make the adoption of the metric system compulsory."

CURES *for* COMMON SHOP COMPLAINTS

By J. A. Lucas





Gear Steels*

BY DR. J. HEBER PARKER
Carpenter Steel Co.

There was a time, not so very long ago, when gears of ferrous metal were made entirely of cast iron. When gears of steel came into use the manufacturer who could advertise that the gears in his machines were cut from solid steel blanks thought he had reached the acme of perfection in the strength and wearing qualities of his gears. He never heard of case-hardened gears or gears made of carbon steel and hardened, nor would he have believed such things possible. The service demanded of gears in the automotive industry has changed all this and the author of this paper tells us of the composition of steels that are suitable for gears which are either to be case-hardened or hardened and tempered by simply heating and quenching.

FROM a commercial standpoint, gears may be divided into three groups—gears for automotive service; gears for electric car service, and what may be called commercial or jobbing gears.

Gears for automotive service include those used for automobiles, both trucks and pleasure cars, airplanes, tractors, motor boats, machine tools, etc. Upon gears of this group there has been devoted a great deal of study and work as regard different types of analysis and the heat-treatments for each type, and also the matter of design as applied to the metallurgical side of the question, such as minimizing the matter of warpage in hardening, etc. In fact, it may be said that the story of the development of gear steels for automotive work is in great part the story of the development of alloy steels of the last 15 years with which the writer has been closely connected.

Steels for this work are divided into two groups—steels for case-hardened gears, where there is a hard surface and soft core, and steels for tempered gears, where there is uniform hardness throughout the entire tooth section. Much has been said about the relative merits of each group. It is a long story and may be passed over by expressing the opinion that, in a general way, each has its own special field, the case-hardened gears for constant mesh service, and the tempered gears for change or clash gear service. Certainly the tempered-steel clash gear does not realize the experience of the case-hardened gear in the same service, when hard, case-hardened clash faces are chipped off with the resultant exposure of the soft core, and consequent trouble with bearings impregnated with hard-steel chips. Tempered gears have sometimes been criticised on account of pitted tooth surfaces which were found after limited service. It is believed that this pitted condition is caused by excessive unit tooth pressure due to several causes. A few experiences where the condition of pitted surfaces was corrected may be of interest.

CAUSES OF PITTING

First—Misalignment of gears was believed to be the cause of the trouble, thus throwing an excessive load upon only a part of the tooth and vastly increasing the unit tooth pressure. When the gears were properly adjusted and the load properly distributed, pitting disappeared.

Second—A little lower drawing temperature after hardening which resulted in an increase of about five points in scleroscope hardness eliminated pitting. The slight increase in hardness was sufficient to enable the gear tooth to withstand the unit tooth pressure put upon it.

Third—The horsepower of a car had been changed without any change in the transmission. The pitting which occurred was eliminated by increasing by ½ in. the length of the tooth face. This increase resulted in decreasing the unit tooth pressure to a safe figure. Properly case-hardened gears, which have a scleroscope hardness of about 90, will undoubtedly withstand, without pitting, unit tooth pressures which will give trouble in the case of a tempered-steel gear which is about 75 scleroscope hard. The case-hardened gear, however, is not as tough nor strong, and in clash service has the disadvantages before mentioned. The tempered gear also will warp less in heat-treatment than the case-hardened one, for it reaches an elevated temperature only once in heat-treatment, and that for only a few minutes as compared with the long high heat for carburizing, and two subsequent elevated hardening temperatures for treatment after carburizing.

For automotive work case-hardening steels of six types are generally used, three of the types quite commonly, while the other three have a more restricted use on account of their higher cost with, perhaps, a little more careful heat-handling requirements. Table I gives type analysis of each, together with the physical properties of the core, when properly heat-treated, which may be expected when these steels are made by mills having more of a quality than a tonnage perspective.

CARBURIZING

The physical properties given in the table were secured by treating standard test pieces in sand for the length of time and at the same temperature, as would be used in carburizing, for the various types of steel. Test pieces were then allowed to cool in a box and given a full double treatment which would have been given a piece of the respective steels to put them in their best possible case-hardened condition. Test pieces were then ground to size and pulled.

TABLE I. ANALYSIS AND PHYSICAL PROPERTIES OF CASE-HARDENING STEELS

Name	C.	Mn.	Si.	P.	S.	Cr.	Ni.	E.L.	T.S.	El.	Red.	Brinel	Sclero	Guillery Impact	Sclero of Case
Simple carbon	0.20	0.50	0.20	0.04	0.04	....	....	50,000	75,000	20	55	190	30	18 Kgm	90
Mild chrome nickel	0.20	0.60	0.20	0.04	0.04	0.40	1.25	100,000	150,000	12	40	287	40	10	90
3½ per cent. nickel	0.20	0.60	0.20	0.04	0.04	....	3.50	105,000	160,000	13	45	302	50	11	90
5 per cent. nickel	0.15	0.40	0.20	0.04	0.04	....	4.75	125,000	175,000	15	50	321	54	10	90
Medium chrome nickel	0.17	0.40	0.20	0.03	0.03	1.00	1.75	140,000	180,000	13	50	340	58	11	90
High chrome nickel	0.12	0.40	0.20	0.03	0.03	1.25	4.00	150,000	200,000	13	52	375	60	10	90

In regard to the operation of carburizing, so much has been written upon this subject that it would be superfluous to go into it here in detail. Case carburizing compounds have been very thoroughly developed and compounds are available which will produce in the case different carbon contents, that is, 0.60 per cent., 0.80 per cent., 1.00 per cent. carbon, etc.

Carburized pieces should not be quenched directly from the carburizing box, except in cases where a hard surface only is desired and nothing in the way of strength and toughness of core is expected. If carburizing temperatures are relatively low; that is, about 1550/1560 deg. F., good results may be obtained by a single quench after pieces have cooled in the carburizing box and have again been reheated to the proper temperature. For best results, however, a double quench after carburizing is desirable; the first quench from a temperature sufficiently high to refine the core, which is low in carbon, and the second quench at a proper temperature to refine the case, which is very high in carbon. Drawing after final hardening is desirable to relieve hardening strains and to secure increased toughness.

*A paper presented at the annual convention of the American Gear Manufacturers' Association, Cleveland, Ohio, Apr. 15, 1919.

Warpage of case-hardened gears as a result of heat-treatment always occurs to a greater or less extent. The warpage will be somewhat reduced if care is taken to anneal forgings before machining.

Forgings as they come from the hammer, and cooled under varying conditions, always have some internal strains. The release of these strains by annealing leaves the metal in a state of rest which makes possible a decrease in warpage in the finished pieces, for without the annealing, the strains in the metal due to forging often are relieved during the case-hardening operations, with the result that they are the direct cause of some of the warpage experienced.

Tempered gears are made principally from four types of steel, two of which are in common use while two types are more rarely used, especially one of the latter, an air-hardening chrome-nickel steel, which has been used very little in this country. Table II gives the type analysis and physical properties of these steels in gear condition.

In addition to these standard types there has been sold a silico-manganese steel of approximately 0.50 per cent. carbon, 0.75 per cent. manganese and 1.50 per cent. silicon, which has, when hardened and drawn for gear condition, an elastic limit of approximately 225,000 lb. per square inch. This steel when properly hardened remains practically constant as to size, and has proved most satisfactory as a steel for clash or change gears.

Gears for Commercial or Jobbing Work

This particular field, as the speaker understands it, covers by far the biggest field of work for a number of your member companies. The steel used, or perhaps more accurately speaking, the ferrous materials used, may, perhaps, be put into five groups:

First—Cast iron and semi-steel.
Second—Steel castings.
Third—Unhardened and untreated steel.
Fourth—Case-hardening steel.
Fifth—Tempering steel.

Cast iron and semi-steel—Orders to the foundry usually call for iron castings, meaning an ordinary gray-iron casting, without any chemical or physical specifications. Physical tests of ordinary cast iron, as given by Kent, show a tensile strength of from 20,000 to 22,000 lb. per square inch. The elastic limit is not clearly defined for cast iron and is usually not given. There is also, as you know, no ductility; break occurs and that is the end of it.

The hardness is extremely variable and varies with the size of section, temperature of casting, and the analysis of the iron. But in any event it is quite low.

Semi-steel is a name given to cast iron to which has been added, by melting in the cupola, steel scrap of varying proportions up to 20 per cent. or even 30 per cent. The addition of steel increases the density of the iron and also its strength, and results in better wearing qualities on the gear teeth than is obtainable with cast iron alone.

Steel castings—Steel castings for gears unless the analysis and physical properties are specified will usually be found to have approximately the following analysis and tensile properties:

	Per Cent.
Carbon	0.30 to 0.40
Manganese	0.40 to 0.75
Silicon	0.20 to 0.50
Phosphorus	Not over 0.06
Sulphur	Not over 0.06
	Lb. per Sq.In.
Elastic limit	25,000 to 35,000
Tensile strength	60,000 to 70,000
	Per Cent.
Elongation in 2 in.	18 to 22
Reduction of area	25 to 30

Unhardened and untempered steel—Steel for this class of gears is usually picked up out of warehouse stocks by the gear maker and is generally considered by him as good or bad, depending entirely upon his ability to machine it easily. It may represent almost anything from 0.15 per cent. to 0.40 per cent. in carbon with usually very high values for manganese, phosphorus and sulphur, the latter two elements being those whose presence are necessary in relatively large amounts in order to insure easy machining. The tensile strength of steel of this charcater will vary between 55,000 and 70,000 lb. per square inch with an elastic limit approximately half of this amount and an elongation of 20 to 30 per cent. in 2 in. For gears of ordinary service it is undoubtedly superior to either cast iron, semi-steel or steel castings untreated, but, of course, cannot compare in service with either the case-hardened or treated gears.

Case-hardening steel—This steel is purchased in bar form, in forgings and in rolled blanks. The standard analysis is as follows:

	Per Cent.
Carbon	0.15 to 0.25
Manganese	0.40 to 0.60
Phosphorus	Not over 0.04
Sulphur	Not over 0.05

Steel with carbon over 0.25 per cent. should not be used except in very special cases on account of the hard brittle core which will result, and where tooth sections are relatively small it would be well to hold the carbon to 0.20 per cent. as a maximum. The same remarks regarding case-hardening treatment apply here as given under case-hardening steel for automotive work. In a general way, the physical properties in the core may be expected to closely approximate those given above for simple carbon steels.

Range of Carbon Contents

Tempering steels—Again bar stock, forgings and rolled blanks represent the conditions in which this steel reaches the gear maker. A handbook, by a steel manufacturer of forged and rolled carbon steel spur-gear blanks, gives two ranges of carbon contents for this type of work. The medium grade of 0.35 to 0.50 per cent. and the hard grade of 0.55 to 0.65 per cent. carbon. The speaker is of the opinion that the latter grade is too high in carbon for quenched gears, and that 0.35 to 0.50 per cent. carbon is the range which will, on the whole, give most satisfactory results from the standpoint of ultimate service, warpage in hardening and breaking either in hardening or in service. The physical properties to be expected from this type of gear will vary considerably, depending upon the carbon content, the size of the tooth section and the quenching medium, whether it be oil, water or other aqueous solution.

TABLE II. ANALYSIS AND PHYSICAL PROPERTIES OF TEMPERING STEELS

Name	C.	Mn.	Si.	P.	S.	Cr.	Ni.	E.L.	T.S.	El.	Red.	Brinell	Sclero.	Guillery Impact
Medium chrome nickel, Type "A"	0.50	0.40	0.20	0.03	0.03	1.00	1.75	260,000	300,000	6	16	495	76	5 Kgm
Mild chrome nickel, Type "B"	0.50	0.40	0.20	0.03	0.03	0.7	3.00	235,000	260,000	7	18	444	74	5
High chrome nickel	0.40	0.40	0.10	0.03	0.03	1.25	3.50	250,000	285,000	6	18	490	7(	5
Air-hardening chrome nickel	0.30	0.40	0.20	0.03	0.03	1.50	4.50	220,000	255,000	9	22	460	70	7

In a general way, an 0.40 per cent. carbon steel 1 in. round as rolled will show approximately:

	Lb. per Sq.In.
Elastic limit	50,000
Tensile strength	90,000
	Per Cent.
Elongation in 2 in.	20
Reduction of area	40

The use of case-hardening and tempering alloy steels, in place of simple carbon steels, for jobbing or commercial gears undoubtedly will largely increase. The speaker believes this development can be made especially promising in the field for gears made of alloy-steel castings, where the use of the electric furnace makes possible a better grade of alloy-steel castings than could be formerly obtained. Just one instance of one type of service will show the possibilities. Sixteen-inch merchant mill pinions made of 0.40 per cent. simple carbon-steel castings untreated, lasted in service on the average from 9 to 12 months; 0.50 per cent. carbon chrome nickel-steel castings heat-treated, lasted on the same job seven years and are still going. The possibility for a gear maker in developing a

field of this kind seems almost without limit, especially if this development is worked out in close coöperation with a steel foundry making electric steel castings.

Special attention should be paid to the matter of design of castings which are to be case-hardened or tempered. Sections throughout the casting should be as nearly uniform as possible, and a little extra weight to accomplish this will more than pay for itself. Sharp or short angles should be avoided for they are sure to result in trouble during heat-treatment. Sharp machined angles at the bottom of keyways also should be avoided for the same reason.

Whether gears or pinions are made from castings or forgings, the metallurgist, from a theoretical standpoint, would design them to be of uniform section, with no overhanging teeth, with no undercut teeth, and with no sharp angles either cast or machined; he would have a steel sound and in good condition, of the proper chemical composition for the particular heat-treatment to be given, and annealed to relieve all strains before machining; he would have a heat-treating equipment in line with the high-grade machine tools of which the mechanical man likes to boast, and controlled by pyrometers the accuracy of which is maintained to compare favorably with the micrometer measurements of the finished gears. The nearer this ideal is attained, the better will be the gears produced.

And now, just a word about steel making. Most of the steels you are using, with the exception of electric steel castings, are melted in the open-hearth furnace. You are going to hear a great deal in the near future about electric steels. Clever salesmen will speak in a mysterious way about the wonderful effect electricity has upon the steel, etc. You, of course, realize that the electric current provides only the heat, the fuel if you will, to melt the steel and to provide the temperature necessary to refine it. The electric furnace, with its ease of temperature control, its ability to provide reducing conditions for the bath, and its elasticity of handling, provides the opportunity to make steel of exceptional quality. The steel produced, however, will vary from an ordinary open-hearth grade up to a crucible grade, depending upon the skill and previous experience of the maker. The maker with the large tonnage perspective does not and will not make the same quality of electric steel as the maker of crucible steels who has had for years a quality perspective. Their standards of quality and their methods of manufacture are entirely different from the time the steel is melted until it is shipped. When, therefore, you want the best electric steels produced, the steels which will give you maximum service, look up the makers with the quality perspective, the quality reputation.

Wage Disputes and Cost of Living

By L. W. ALWYN-SCHMIDT

The readjustments in working conditions which are now going on in all sorts of shops are offering us fine opportunities for improving these conditions and also the relations between workmen and employers. If the opportunities are accepted in the right spirit by both sides the chances are that changes for the better with lasting results can be effected.

LABOR unrest is a disease for which there is no complete cure, but there are means to mitigate its evil influence on industry. The work has to begin in the factories and workshops and must be a part of the effort to bring the men to a realization of the fact that their prosperity is not an individual experience of their own but rather the result of a corresponding prosperity of the whole.

On the other hand, there remains the unfortunate fact that the same factors of extensive and well-paid employment which benefit the men also attack their economic position by raising the cost of life's necessities. The effect of high wages is neutralized by the decline of the buying power of the dollar. This is an experience which we have all undergone during the last four years and high prices doubtless are at the bottom of much of the present dissatisfaction in labor circles.

The time has come when both workman and employer must face this problem with a view to finding a more satisfactory solution than those so far attempted. The strike may seem an easy way to enforce a discussion of the grievances of labor and the resulting higher wages may bring a momentary relief. But it is a very crude way of settling a dispute because it leaves in abeyance the most essential part of the controversy, its underlying cause. This has been realized with increasing clearness during the last few years and has led to various attempts to eliminate the variation of the cost of living as a factor in wage disputes. No satisfactory solution of the problem has yet been found, but the need is so great that even the small progress that has been made so far deserves the attention of all those dealing with the handling of labor.

The problem of adjusting wages both to the individual earning capacity of the operator and to the relative buying power of the dollar is especially difficult in the machine construction industry. Many of the American machine shops are doing nothing but contract work, and the quality and extent of their services constitute the commercial commodity which they offer to the market. To keep the cost of these services at a competitive rate and to adjust it always so finely as to secure to all the workers that income which is commensurate with the general economic condition of the country, is no easy matter.

Problem of Wage Stabilization

For the production engineer the problem appears in the form of wage stabilization. It is to the interest of the shop to have an operating force as nearly uniform in number and productive ability as is humanly possible. In order to keep down the number of changes in the force, the men should be satisfied with the conditions of their work, and to maintain efficiency they should be free from economic worries. There should finally be the knowledge that the job is safe and worth keeping.

View may differ on what constitutes a living wage, but there is no doubt that even under difficult circumstances an agreement can be reached on a minimum wage scale, which, prior to 1914, there was little difficulty in sustaining. Men who were not satisfied with their earnings could either improve their services and qualify for better-paid jobs, or they could leave the work. Others could be found to take their places. Unfortunately, in recent years minimum wage arrangements have lost a good deal of their value to the men and the employers owing to the unreliability of the

basic purchasing power of the monetary unit. As the problem seems to be caused nearly entirely by the rise in the cost of living it has been attacked mostly in this direction. The method of attack has varied, but in the majority of cases no other solution has been found than that of raising the wages of the men from time to time.

Wage increases, however, are far from satisfactory in dealing with variations in the cost of living. The trouble reappears almost immediately after an increase has been granted and the men are always bound to be the losers in the race against mounting expenses.

The Wage Dispute Problem

The shop is no better off than the men, for a wage dispute coming in the middle of a large contract may overthrow the whole cost estimate and turn an estimated profit into a clean loss. The consequence is resistance by the management to the demands of the men and very likely a strike results which does not improve matters, but makes the situation worse. The problem must therefore be attacked from another quarter. Wages must be adjusted automatically to the purchasing power of the dollar.

To illustrate the problem, a small example may suffice. Suppose that our factories would pay in goods instead of money. Let the weekly ration of a man consist of a dozen eggs, three quarts of milk, six quarts of potatoes, six pounds of meat and other commodities. If the factory had to buy these goods every week it would have to pay the existing market price. The monetary payment to the men is really the equivalent of these commodities in cash. If the purchasing power of this equivalent is sufficient only to supply 9 eggs instead of twelve and only 4 pounds of meat, the man is not getting his full equivalent. He will be dissatisfied with his earnings and will demand more.

Commodity as a Basis for Wage Payment

The factories which have tackled the problem in their general wage policy have agreed upon the quantity of commodities or their equivalent value due to each man as wages, and have made good his monetary loss by adding to his wages the difference between the assumed value of the commodity and the price for which it might be purchased. The second solution is that of keeping down the cost of the ordinary necessities of life to an agreed level by artificial means, thus obviating an adjustment of the wage scale because living conditions are constant.

In Europe where the labor is generally far more stationary, the solution lies in stabilizing living conditions. Labor legislation, factory benefit associations, coöperative stores and the formation of special labor colonies have all contributed to success. When coöperative stores exist, the company has only to pay an increased amount to them when the cost of living rises, so that the same wages will purchase the same amount of necessities and the loss to the store is paid by the company. Some of the large railroad shops in South America have tried the scheme of paying their men partly in cash and partly in trade money which was accepted at the company's store and whose value could be stabilized.

A variation of this general system consists of the arrangement of rebates with the local merchants which are not payable at once but on a quarterly basis. This scheme was extended to include the lower salaried officials of the company and when hard times came they were glad enough to avail themselves of the rationing system.

The difficulty with these arrangements is that the men are limited to dealing with only certain shops, a restriction which would hardly suit the American workman.

The American method of stabilizing wages as mentioned above is open to objection in that it complicates the cost figures on the product. There is no reason, however, why the same amount which was added to the wages should not be added to the selling price of the product, thus maintaining the balance between labor cost and sale price.

The economic life of the world has undergone enormous changes during the last four years, and no force, however strong, can bring us back again to the summer of 1914. There is no denying that wages are in the decline again. No force whatever can hold them on their present level, and when they drop the artificially inflated commodity prices will go with them. The old system of striking for higher wages, of arbitrary agreements which are useless to both parties when they are made, has failed to produce results and will probably find its final doom during the coming readjustment. It is time to try something new, holding a better promise for permanency, and the introduction of wage agreements based on the varying purchasing power of the dollar may prove a solution.

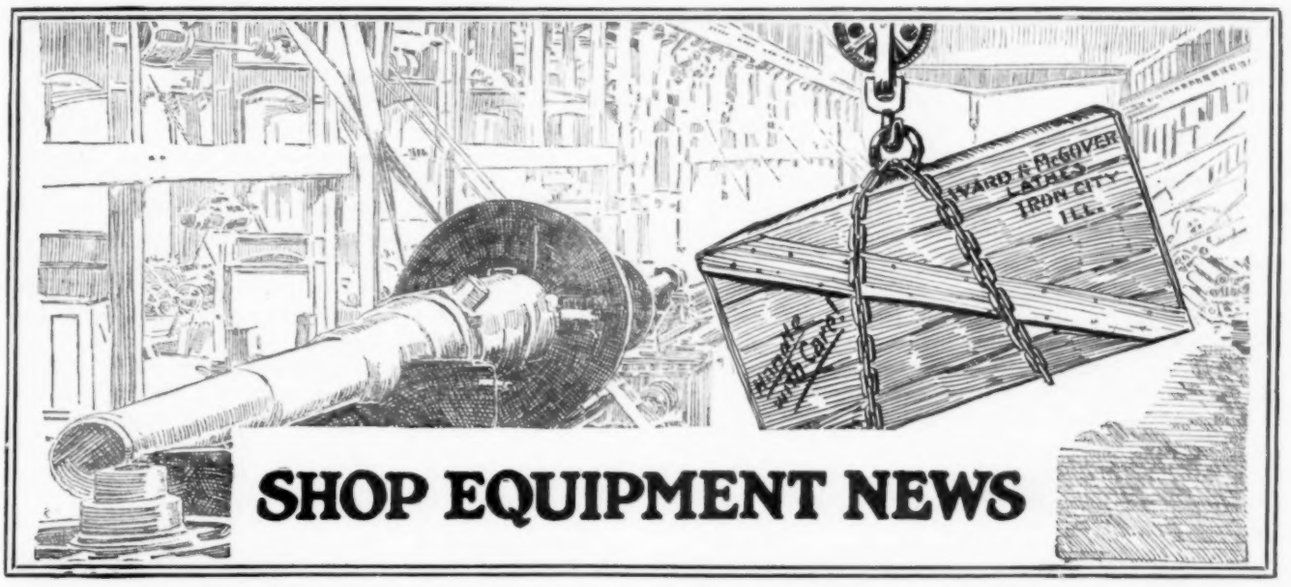
Reducing Idle Machine Time

By C. Hamilton

In a good-sized machine shop with which I am connected the tool-shop foreman is also in charge of all ordinary machine repairs. Under the pressure of Government work the oiling of machines and shafting, to say nothing of the air hoists of which we have nearly a hundred, became as perfunctory as the motions of a sleepy hound scratching fleas.

As a result shut-downs for galled shafts and burned bearings kept the repair gang on the jump and production lagged. Machinists were at a premium and scarcer than hens' teeth, and the boss was in a quandary. Finally he dug up four or five old chaps whose production days were over but who could still navigate, and set them to work as shaft nurses. One man was given a can of grease and an oiler, and was introduced to every air hoist in the shop. He was constantly on the go, and air hoists which had almost forgotten the existence of lubricants took a new lease of life with a joyful sputter. Failures in this section were almost entirely eliminated and the shafting troubles were reduced 50 per cent. in the first month of the new system.

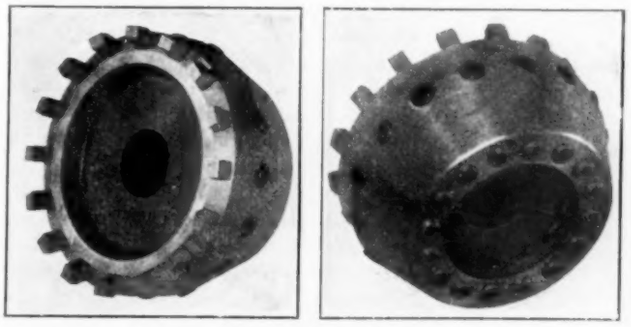
The shop was divided into sections and each man was made responsible for his section and every oil pocket in it. The machine operators were relieved of all responsibility of routine lubrication and only took care of the necessary oiling incident to the work they were doing. Production promptly took a climb and the tool-shop foreman had time to change chews and pass the time of day occasionally without wondering where the next S. O. S. was coming from. He even had time to build a new jig once in a while and get production out of his own department instead of keeping his expensive toolmakers on the jump doctoring sick machinery.



SHOP EQUIPMENT NEWS

Runde Face Mills

The R. W. Runde Machine, Tool and Die Works, Detroit, Mich., has just placed on the market a line of hardened-body face mills one of which is shown in the illustration. The mills are made in sizes as desired and



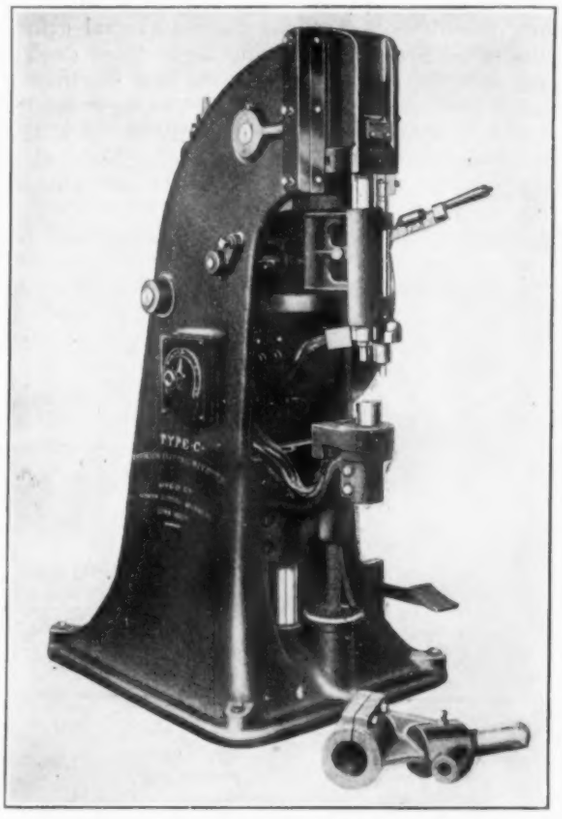
FRONT AND BACK VIEWS OF THE RUNDE HARDENED-BODY FACE MILL

adapted for various types of milling machines. The advantages claimed are, that the cutter always maintains its original diameter automatically; the individual blade adjustment permits grinding the blades by hand without removing the body from the machine; there is a comparatively small surface to be ground; both ends of the blades can be used allowing the ends to be made with different shapes if desired; only five minutes are required to grind and replace a set of blades; blades too short for use in the cutter can be used in lathe, shaping-machine, or planing-machine toolholders; additional sets of blades may be obtained without excessive cost, and a hardened body making for long life.

Thomson Type C Electric Riveter

The illustration shows the Type C electric riveter now being marketed by the Thomson Electric Welding Co., Lynn, Mass. This machine is of medium size and will handle any commercial lengths of rivets successfully from $\frac{3}{8}$ up to $\frac{3}{4}$ in. in diameter.

The rivet to be headed is first set in place in its hole and the work is then laid on the lower die of the riveter so that the under head of the rivet rests in a small recessed pocket provided on the face of the lower die. The head is swung to the left by the controlling lever, bringing the copper die at the right directly over the rivet shank. By pulling down on the operating handle the copper heating die is forced into



THOMSON TYPE C ELECTRIC RIVETER

contact with the upper end of the shank to be heated. Pressure on the push button at the outer end of the controlling handle turns on the current and heats the rivet. When the rivet is heated to the proper degree the pressure on the hand lever is released and the

head swung to the right, bringing the steel heading die in line with the rivet. The foot treadle is then depressed, engaging a clutch that causes the heading die to make one full down stroke only and return to its starting position when the clutch is automatically disengaged. A safety device is provided that prevents any premature depression of the foot pedal by a careless operator or by accident, this device making it impossible for the power press to act unless the steel die is in proper position.

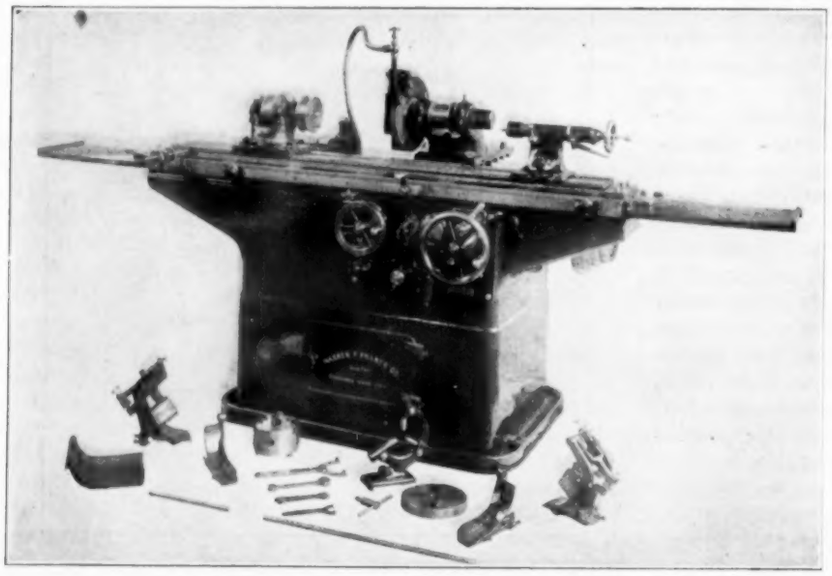
The press is constructed with a spring-cushion release having an adjustable tension, this feature being said to remove considerable stress from the press in case a rivet happens to be a little long. Another advantage of this type of construction is that rivets of different lengths may be used without any additional adjustment of the pressure springs. Another feature claimed for the machine is that by proper manipulation of the heating die with the operating handle the heat can be made to commence about the middle of the rivet shank, this method of heating being said to give a much better filling of the rivet holes than is possible where the rivets are first heated and then put in place. It is also stated that the slow squeeze given by the press gives a much better filling effect than hammer blows.

Fraser Universal Grinding Machines

The Warren F. Fraser Co., Westboro, Mass., has recently placed on the market four universal grinding machines that are somewhat similar to those described on page 270, Vol. 49, except that the new machines are arranged for countershaft drive. The new machines are known as No. 2-C with a capacity of 10 x 30 in., No. 2-AC with a capacity of 12 x 30 in., No. 3-C with a capacity of 10 x 42 in., and No. 3-AC with a capacity of 12 x 42 in.

The bed is built in two sections, the sub-base being cast hollow and ribbed internally, and arranged to rest on the foundation at three points in order to preserve alignment. The wheel-stand slide is supported on the base which, together with the sub-base, forms a continuous support reaching to the floor. The slide is so designed that the wheel can be used in any position without interference. Transverse movement of the wheel slide is controlled by a handwheel having a micrometer dial, the working parts being protected from dust and water by a metal cover. The automatic crossfeed has a range of adjustment from 0.00025 to 0.005 at each reversal of the table, and may be adjusted to operate at each alternate reversal of the table. The wheel spindle is of hardened steel ground to size and runs in bronze boxes provided with adjustment for wear. The wheel is mounted on a collet that is attached to the spindle by a nut and taper fit so that additional wheels may be mounted on collets and changed quickly for special work.

The swivel table turns on a hardened and ground central stud and is provided with a scale reading to 6 deg. and also to 2½ in. of taper per foot in both directions. The table has a slot of special form so that the head and tailstocks are aligned against the front edge of the table in clamping. The motion of the table is controlled by dogs, the brackets for which slide on racks to allow for quick adjustment. Screws are fitted for fine adjustments. The table moves on one V- and one flat-way, the wearing surfaces being protected from dust by metal covers, oil being distributed by means of rolls in oil pockets. Three wheel speeds, eight table speeds and eight work speeds are provided. The reversing mechanism is a special feature. It is stated that this allows work to be ground close up to a shoulder. It is provided with means to give a slower travel close to the reversal than in the central part of the traverse, this completely grinding work close to the shoulder and also allowing an easier reversal of the carriage. It also allows higher rates of table traverse. The headstock is arranged to swivel through the entire circle and is graduated to read in degrees. The spindle is of hardened and ground steel and runs in bronze boxes that are adjustable for wear. The tailstock is provided with both lever and screw action, and is also equipped with a device that allows spring tension or rigid action to be used as desired. It is also provided with a holder adapted to receive carbon points so that the wheel can be trued without removing the work. The lubricant pump is of the submerged centrifugal type, with all bearings above the liquid. The flow is regulated by a valve located above the wheel. An internal grinding fixture is supplied that is of the high-speed ball-bearing type with a maximum spindle speed of 25,000 r.p.m. The standard equipment consists of one four-jawed chuck, faceplate, two universal back rests, one center rest, two adjustable dogs, set of telescopic water guards and wrenches. The back rest supplied can be used either universal or plain.



FRASER UNIVERSAL GRINDING MACHINES

Made in four sizes, No. 2-C 10 x 30 in., No. 2-AC 12 x 30 in., No. 3-C 10 x 42 in. and No. 3-AC 12 x 42 in.; automatic crossfeeds, 0.00025 to 0.005 in.; size of wheel, 10 in. in diameter with 3-in. hole and thicknesses up to 1¼ in.; graduations on swivel table, up to 6 deg. on each side or up to 2½-in. taper per foot in both directions; wheel speeds, three, 1910, 2300 and 2875 r.p.m.; table speeds, eight, 10 to 165 in. per min.; work speeds, eight, 17 to 340 r.p.m.; diameter of front spindle bearing, 1¼ in.; diameter of spindle nose, 1⅞ in.; taper hole in spindle, No. 2 Morse; speed of internal grinding fixture, 25,000 r.p.m.; weights, No. 2-C machine, 3300 lb., No. 3-C machine, 3700 lb.

Sullivan Air or Steam Hammer

A hammer built by the Sullivan Machinery Co., Chicago, Ill., known as its "Utility Hammer" is shown in the illustration. It is especially adapted for forging either pick- or chisel-point cutter bits, chisels, wrenches or small tools of all kinds, straps, levers, keys and wedges, or the thousand-and-one jobs that come along in any fair-sized machine shop. The strokes are controlled by a foot treadle and a single blow or many in succession may be struck, and either light or heavy, as desired. A very powerful "slugging" blow may be obtained at full stroke.

SULLIVAN UTILITY HAMMER

Specifications: Throat from center of die to face of column, 15 in.; will take work up to 2 in. thick; hammer is capable of 600 strokes per min.; net weight, 1675 lb.; over-all height, 6 ft. 6 in.; depth of base, 29 in.; width of base, 16¼ in.; hammer cylinder, diameter, 55 in.; hammer cylinder, stroke 5¾ in.; air pressure required, 80 to 100 lb.; air consumption at 90 lb., 93 cu.ft. per minute; total striking weight, 100 lb.

The use of air to run this hammer is claimed to have a number of advantages over a belt drive, as the air-thrown valve gives a wide range of striking power and great sensitiveness of blow. The air exhaust can also be used to blow chips and scale from the die, which is very important where cut dies are used. The hammer may be had equipped for the use of steam where desired.

Beaman & Smith Continuous Manufacturing Milling Machines

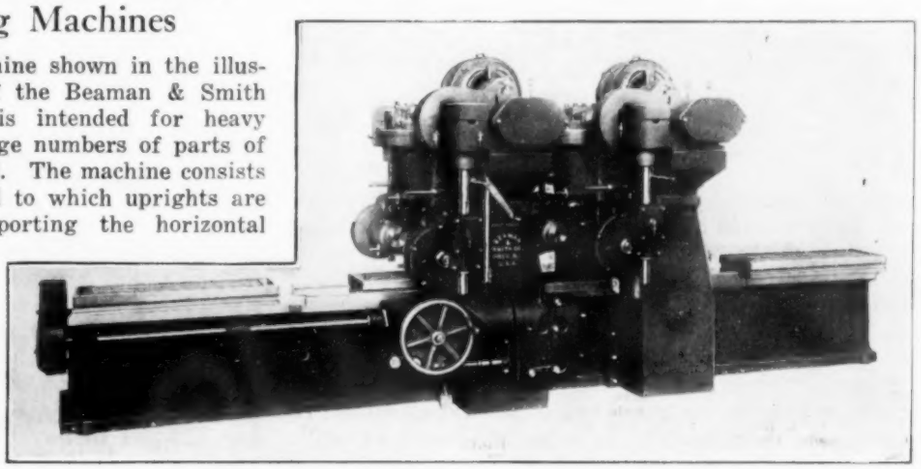
The continuous milling machine shown in the illustration is a recent product of the Beaman & Smith Co., Providence, R. I., and is intended for heavy manufacturing work where large numbers of parts of the same type have to be milled. The machine consists essentially of a substantial bed to which uprights are attached, these uprights supporting the horizontal spindle heads and the cross-rail, which in turn carries the vertical spindle heads. Each pair of uprights with its bank of spindles is one milling unit. As many spindles can be mounted on this unit as necessary and as many units may be attached to the bed as are required to do the work in hand. The feed-driving mechanism is carried on one unit only and the removable tables that carry the work are fed along the bed, taking a fast motion when the cutters are idle and a slow motion when the cutters are working.

These tables, after having passed all cutters, are lifted from the bed and the finished work removed, while another table with the work in place is placed on the front end of the machine and the process repeated. Four tables are generally necessary to maintain continuous milling. The tables travel on flat-ways with slight tapers on the inside edges to accommodate corresponding tapers on the bottoms of the tables, these serving to center the tables without wedging and allowing them to be put on and removed easily. When traveling under the cutters, the tables pass under gibs fastened to the bed, to guard against any upward motion while the cut is in progress.

The feed shaft runs the entire length of the bed and is driven from the front end. It carries a number of worms, so spaced that the traveling tables are picked up by one worm before they have left the preceding one. The spacing of the worms makes it impossible to set a table in the wrong position on the bed, and no matter where set it will pick up and travel instantly. The feed and fast motion are available in either direction. Gearing is used to secure four changes of feed, which vary from approximately 3 to 8 ft. per min. with a fast motion of about 12 ft. per min. when the cutters are idle. Two changes are possible through change gears at the end of the gear box, while two more are secured through a feed-box gear-shifting lever. The feed and fast motion are controlled by a single lever, this construction making it impossible to engage both at the same time. The feed is driven through a vertical shaft connected by bevel and reducing gears to the main drive shaft.

A motor is furnished to drive each separate unit, the motor-driving mechanism being carried on the crossrail supported by the upright, the drive being through gears. Change gears are incorporated in order to allow the various spindles to be driven at high speeds.

The spindle heads are cast in one piece and are moved along the ways by hand-operated screws, wear being taken up by taper gibs. Clamps are incorporated to secure the heads firmly in place when the desired positions have been secured. Three standard sizes of spindles are made, the diameters of the front bearings



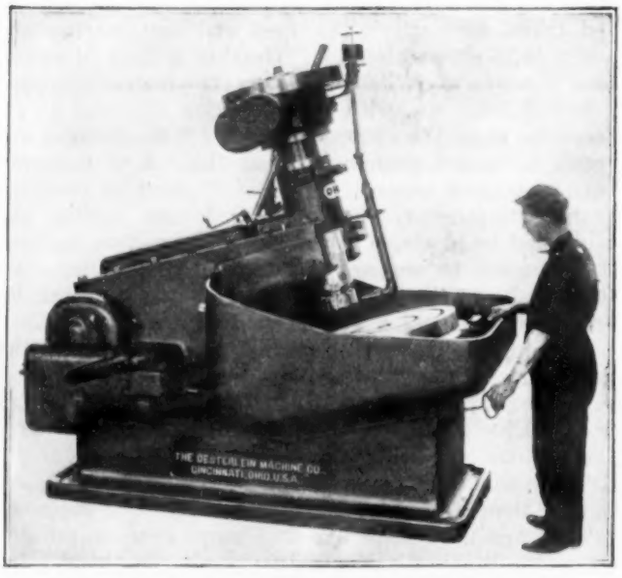
BEAMAN & SMITH CONTINUOUS MILLING MACHINE

being 3⅝, 4⅝ and 5⅝ in. respectively. They are provided with hand in-and-out adjustment by means of a rack-and-pinion mechanism, the pinion being for adjustment only, the quill being held in final position by clamps. The control of the machine is centralized at the unit that carries the feed gears.

"Ohio" Tilted Rotary Milling Machine

The Oesterlein Machine Co., Cincinnati, Ohio, has just developed and placed on the market a new type of milling machine that is known as the "Ohio" tilted rotary. The machine may be used either as a station machine or for continuous milling. The chief features claimed are the great rigidity, the elimination of considerable idle time between cuts and the construction that enables a generous supply of lubricant to be supplied to the cutter.

The body of the machine is cast in one piece and the spindle head is suported by a ram that slides in ways, the construction being somewhat similar to that of a shaping machine except that the ways are inclined 15 deg., the table also being inclined so that the motion of the spindle head is at right angles to the table axis.



"OHIO" TILTED ROTARY MILLING MACHINE

Inclination of table, 15 deg.; diameter of table, 30 in.; worm for table drive, 4 in. in diameter, 1¼ pitch; taper in spindle, No. 16 B. & S.; capacity of lubricant pump, 35 gal. per min.; capacity of reservoir in base, 60 gal.; indexing mechanism for table, 2 to 72 divisions; width of belt, 4 in.; spindle speeds, 30 with 15 pairs of change gears; diameter of lower spindle bearing, 4½ in.; weight of flywheel on spindle, 250 lb.; area of table bearing, 475 sq.in.; area of ram bearing, 1000 sq.in.

The spindle is driven from the pulley through miter gears, an intermediate shaft, change gears, and a set of bevel gears; the intermediate shaft being splined to allow for the reciprocation of the ram. The intermediate shaft is made in two sections so that by uncoupling and turning the first change-gear shaft the direction of rotation of the spindle can be reversed. The spindle is carried in a sleeve, the upper end of which is attached to the speed-box casting. The lower bearing is of phosphor bronze while the upper is of the radial-thrust ball type. The spindle sleeve may be moved in the spindle head, the barrel being split for clamping the sleeve after adjustment. In order to prevent vibration of the spindle a flywheel weighing 250 lb. is mounted on the upper end.

The ram is fed radially over the surface of the table by a cam giving a slow motion during the cutting stroke and a rapid reverse. The travel of the ram is adjusted by a slide operated by a lever at one side, and a double-row ball bearing serves as a cam roller. The camshaft is driven by a worm and wormwheel in the feed box, a four-gear feed-change mechanism regulating the feed of the table when continuous table motion is desired or the rate of motion of the cam when the indexing mechanism is in use. The entire indexing mechanism and cam can be omitted where continuous milling only is to be handled. The feed change gears regulate the rate of travel of the ram while the throw of the cam regulates the length of travel. The indexing mechanism gives from 2 to 72 divisions and is timed by cams on the camshaft wormwheel.

The table is set at an angle of 15 deg. and is driven by a worm and wormwheel, two circular and four radial T-slots being provided for clamping the work.

The lubricant pump is attached to the side of the machine and is belt driven, the lubricant being raised under pressure to a distance above the machine and expanded in a large pipe before it flows to the cutter. The chips carried away by the lubricant are deposited in a pocket from which they may be removed from the front of the machine.

The oiling is centralized at a number of prominent points in order to lessen the danger of some bearings being overlooked. All bearings are of the ball type or of bronze and the table surface and ram slides are of chilled steel.

How Would You Prevent Oil From Discoloring Finished Surfaces?

BY G. R. SMITH

On page 802 of *American Machinist* the question is asked, "How do you prevent oil from discoloring finished surfaces?"

At one time I had charge of 50 machines, all having a considerable area of polished surface, which soon became brown and unsightly from the dried oil. After trying many solutions to remove this I at last found that alcohol would do the trick almost instantly.

Wet a small piece of waste in alcohol and clean off the discoloration, wiping dry with clean waste, and then each week at closing time wipe these polished surfaces and keep them clean.

Bringing Out Over-Exposed Blueprints

BY S. F. GIBSON

When blueprints have been permitted to remain in the printing frame for such a long time that they are over-exposed, they may be restored almost to their normal color by adding about one teaspoonful of hydrogen-peroxide solution to each quart of the water in which they are washed. The procedure is to first wash the prints in clear running water until all the blue liquid which results, has been washed away. Then the prints are soaked in the peroxide solution until the proper color appears. After this, the prints are again washed thoroughly in clear water. A print which has had the correct exposure or one which has been under exposed, will not be adversely affected by the process.

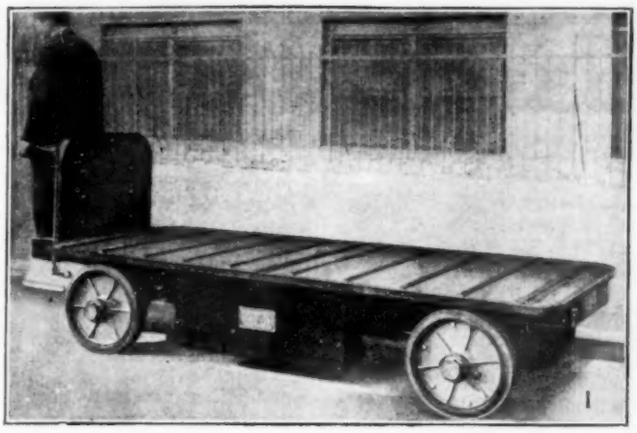


FIG. 1. LONG WHEELBASE TRUCK

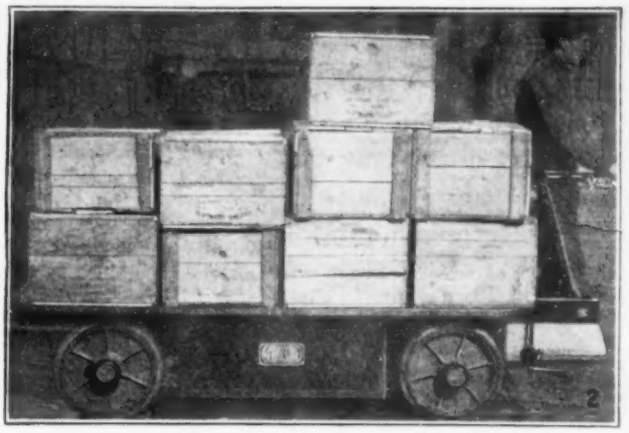


FIG. 2. SHORT WHEELBASE TRUCK

Industrial Truck with New Features

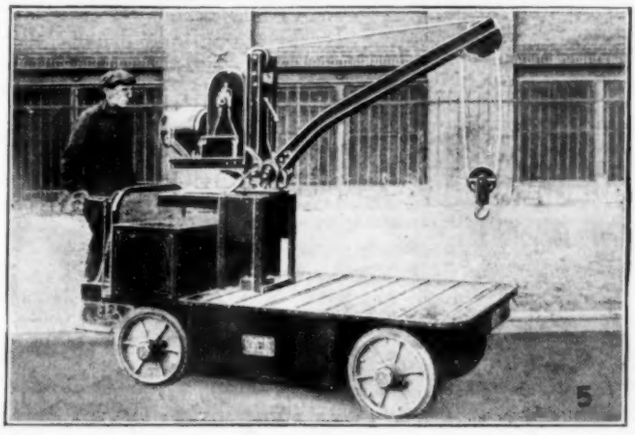
At the New York Motor Truck Show the Karry-Lode Industrial Truck Co. of Long Island City showed an industrial truck which attracted attention because of its similarity, on a smaller scale, to the ordinary motor truck.

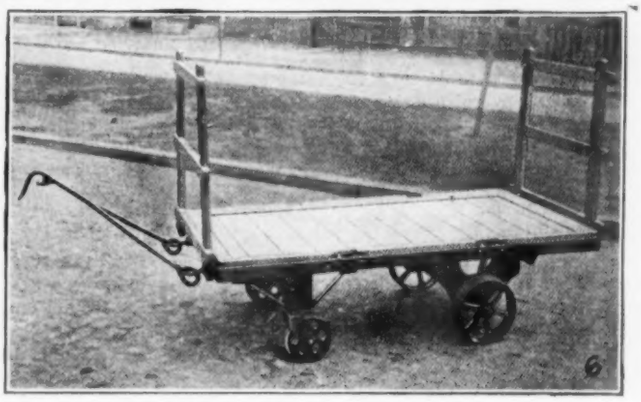
Several models are offered, that in Fig. 1 having a wheelbase of 80 in. and a loading platform 116 x 45 in. The capacity is 4000 lb. and the motive power is a 3½-hp. electric motor wound for 30 volts and 40 amp. Three forward and three reverse speeds are provided; the rated speed on the level is from 1 to 7 m.p.h. and the rated mileage on the level is 25 miles.

The model shown in Fig. 2 differs from that of Fig. 1 only in having a smaller battery and a shorter wheelbase, 60 in. instead of 80. Its performance is the same and its loading platform is 96 x 45 in.

Fig. 3 shows the three-wheel tractor model, which is rated at about the same figures as the trucks and has a drawbar pull of 500 lb. Two steel trailers designed for use with the tractor are shown in Figs. 4 and 6.

The short-wheelbase truck is shown in Fig. 5 fitted with a compensating crane which makes it a valuable vehicle for handling heavy pieces. It is claimed that this outfit will enter a standard freight car without difficulty. The swing of the crane is 180 deg. and it will lift 1500 lb. at a speed of 12 ft. per minute.





FIGS. 3 TO 6. TRACTOR, CRANE AND TRAILER MODELS

Fig. 3—Three-wheel tractor. Fig. 4—Trailer stripped showing frame. Fig. 5—Truck equipped with crane. Fig. 6—Trailer with floor and gates.

Sparks from the

American Steel and Its Part in Reconstruction

Distribution of Steel Rails at Present Extends to Twenty-three Countries To Be Used in Extending Lines of Communication

Another chapter in the story of American steel and the part it will play in reconstruction and in the extension of lines of communication throughout the world is written in the export statistics of rails, railroad spikes, and other iron and steel railway track materials, such as switches, frogs, fishplates, splice bars, etc., shipped to foreign countries since the armistice was declared. The quantity and value of these products exported during the four months ended with March, the average monthly price thereof in December of each year, and the shipments during the calendar years 1911 to 1918 are given below:

Calendar year	Steel rails			Railroad spikes*		Other railway track material (value.)*
	Tons	Value	Price per ton in December	Pounds	Value	
1911	420,874	$12,229,045	$29.11	.....	.....	.....
1912	446,473	13,053,774	29.62	.....	.....	.....
1913	460,553	13,979,549	31.23	25,375,827	$483,283	$3,088,866
1914	174,680	5,103,918	27.05	15,489,687	258,808	1,775,391
1915	391,379	12,095,170	32.65	29,693,252	591,752	4,857,047
1916	540,828	20,417,582	38.43	53,428,813	1,489,091	6,540,187
1917	512,669	24,023,090	52.65	47,467,317	2,009,808	8,194,270
1918	453,944	26,440,780	60.80	22,330,104	1,229,083	5,546,969
December, 1918	44,982	2,735,544	60.80	1,708,554	116,787	541,522
January, 1919	65,024	4,221,563	64.90	3,509,054	189,408	543,330
February, 1919	66,900	4,611,982	68.94	4,206,228	258,073	905,264
March, 1919	48,955	3,051,611	62.30	4,185,816	193,987	515,535

*Not separately stated prior to July 30, 1912.

An analysis of the advance figures for March shows a distribution of American steel rails extending to 23 countries, about 18,000 tons, or over one-third the total exportation, going to France. Cuba, Japan, and Canada were also large purchasers during recent months.

FOREIGN DEMAND FOR STEEL

Early in the history of the steel industry there arose the foreign demand for American steel rails, developing from an average annual exportation of less than 300 tons in the period 1867-1870 to an average of 474,705 tons during the four calendar years of the war period 1915-1918, although the exports did not reach six figures until near the end of the century. From 1900 the volume increased, with slight fluctuations from year to year, until the record-breaking shipments of 540,828 tons, valued at $20,417,582, occurred in 1916. The total shipments of steel rails for the four-year war period were 1,898,820 tons, invoiced at $82,976,622, as compared with 1,502,580 tons, worth $44,366,286, exported during the pre-war period of four years, 1911-1914, representing an increase of 26 per cent. in tonnage and 86 per cent. in value of the total shipments during the war period over the exports for the previous four years.

Like other great staple commodities, the value of steel has soared to unprecedented heights during the war and since the armistice; the average monthly export price of steel rails during the war culminated in the record figure of $62.20 per ton in November, 1918, $68.94 per ton being reached in February, while the advance figures for March would indicate a price of $62.30 per ton of foreign shipments.

In addition to $82,976,622 worth of steel rails shipped during the four-year war period, railroad spikes valued at $5,319,734 and other track material valued at $25,138,473 were exported; or a total of $113,434,829 for all iron and steel railway track materials.

While a greater quantity of these products was shipped to France than to any other country during the war, it is noted that with this single exception Cuba has recently become the leading market for steel rails exported from the United States. From comparatively modest purchases prior to the war, Cuban imports of this commodity during the last three years reached a total tonnage of 187,798, valued at $8,146,383, as compared with 159,335 tons, invoiced at $9,812,418, shipped to Japan; 155,932 tons, worth $6,565,708, to Canada; and less amounts to other countries during the same period.

* * *

Government To Hold Rochester War Plants in Reserve

The War Department is planning to hold in reserve the cannon plant of the Symington-Anderson Co., the Symington Forge Corporation plant on University Ave., and the Symington Machine Co.'s plant on Leighton Ave., Rochester, N. Y. It is understood these plants will be maintained as branches of the Watervliet Arsenal.

New Officers of Wolverine Tube Company

The Wolverine Tube Co., 33rd St. and McGraw Ave., Detroit, manufacturing brass and copper seamless tubes, has been purchased by a group of prominent men of the industry. H. A. Higgins, former president of the company, who represented all of the stockholders in the transaction, said that business had reached such proportions that the officers, who have other business interests, could not handle the company's affairs unless a complete reorganization was effected.

Newcomers include Charles C. Limbocker, president, who has represented A. H. Wells & Co. of Waterbury, Conn., in western territory for the last 10 years; Harry J. Hooks, secretary and treasurer, for the last 14 years representative of the United Wire and Supply Co., Providence, R. I.; George R. Anthony, vice president, who was general manager of the Detroit plant of the American Radiator Co., and William H. Sherman, factory manager. Mr. Sherman was connected with the United Wire and Supply Co., at Providence for 24 years as general superintendent. He is one of the pioneers of the tube industry. The new officers will make extensions and additions as needed.

* * *

French-American Bank Leases Floor

The French-American Banking Corporation has leased the ground floor at 65 William St., corner of Cedar St., New York, and will open for business there about June 1. The lease extends for a period of years.

The corporation is an alliance of the National Bank of Commerce in New York, the First National Bank of Boston and the Comptoir National d'Escompte de Paris, formed to foster trade between France and the United States. It was incorporated at Albany, N. Y., Apr. 29. It is capitalized at $2,000,000, with a surplus of $500,000.

The officers of the corporation are Maurice Silvester, president; Roger P. Kavanagh, vice president and treasurer; John E. Rovonsky, vice president; F. Abbot Goodhue, vice president and Thomas E. Green, secretary.

* * *

Boys from Service Entertained

The employees of the Southwark Foundry and Machine Co., Philadelphia, gave a reception and dance to the members of the company who were in the world war and are now returned. The affair was held in Mercantile Hall on May 6 and was attended both by employers and employees.

World's Industrial Forge

By E.C.Porter, News Editor

Plans Discussed for the Disposal of Waste Material

A committee, representing the National Association of Waste Material Dealers, held a meeting in the office of C. W. Hare, the Director of Sales, War Department, Washington, D. C., to discuss the Government surplus of waste material and the best means of disposing of it to the advantage of the Government and with least disruption to markets.

The Government has in surplus about 605,000 tons of steel and steel scrap, which it was agreed could be best sold by sealed bids.

The non-ferrous metals now held as surplus by the Army were discussed in detail. It was suggested that it would be preferable to sell the aluminum back to the manufacturers to dispose of for the Government at little or no cost, thereby tending to stabilize conditions as much as possible. On the other hand, the committee pointed out that they should have an opportunity to bid on any aluminum and aluminum scrap, for the reason that in many instances they ought to be able to offer very good prices on non-ferrous metals.

There are about 31,907 tons of brass in the form of ingots, rods, sheets, etc., to be disposed of as well as 33,000 tons of field artillery cases, 1000 tons of cartridge cases and 2939 tons of brass scrap in the shape of turnings, etc. Some of this surplus is high-grade brass and some of it is leaded. The committee was advised that the Director of Sales' office is in touch with the brass manufacturers and negotiating with them with a view to their taking over the Government's surplus. The committee called attention to the fact that they should have an opportunity to bid on this surplus because they have extensive markets.

There are about 465 tons of cupro nickel to dispose of in the form of sheets and cupro nickel in the form of turnings. The committee pointed out that it will be difficult to find a market for this metal, as cessation of war has greatly lessened the demand for it. Cupro nickel is used largely in the manufacture of ammunition. The committee recommended that the cupro nickel surplus should be offered to the mills and dealers.

The War Department officials advised the committee representing the National Association of Waste Material Dealers that arrangements had been made whereby all copper and copper scrap is being disposed of by the copper producers, operating through the United Metals Selling Co. The committee was advised that the only copper scrap being sold by the Government would be in small lots of less than 10,000 lb., in certain instances where the Government might be dismantling a certain plant.

With regard to lead and spelter, the committee was of the opinion that it might be advisable for the lead producers to take over the surplus and dispose of it along the lines followed in the case of copper.

* * *

Begins Work on National Association Building

During the past week, work was started upon a building which it is planned to make the national home for all trade associations now located, or which will locate in the future, in New York City. Among the advantages which are expected from this plan are: Closer coöperation between allied industries; greater convenience for business men desiring to see several associations; special advantages for coöperative meeting rooms, and added prestige due to having a high-grade building devoted to the interests of business men in the heart of the hotel, railroad and subway terminal districts of New York.

The building will be near the corner of Fifth Ave. and 43rd St., extending through the block to 44th St. It will be 20 stories high, having about 275,000 sq.ft. of floor space, and will be terraced above the 12th floor to conform to the New York zoning law for conservation of light. An arcade with display rooms will extend through from 43rd St. to 44th St. It is the first large business building enterprise started in New York since the armistice was signed. The contract was let to Fred T. Ley & Co.

The name of the structure will be the National Association Building. It will be ready for occupancy the latter part of next January. Further information may be obtained by addressing Willard C. Brinton, 17 W. 44th St., New York.

* * *

Vacations for All Clark Employees

All employees including those paid by the month, day or hour who have been employed one year will be allowed one week's vacation with full pay, according to a plan announced in February at the annual meeting by Eugene B. Clark, president of the Clark Equipment Co., Buchanan, Mich., manufacturers of internal gear drive axles and disk steel wheels for motor trucks.

The new plan goes into effect this month and includes mechanics, toolmakers, foundrymen and all men irrespective of the basis of employment. Heretofore this privilege has been granted only to officials and to the office and clerical forces of the company.

American Automobiles in Venezuela

Prices Fifty to One Hundred Per Cent. Higher Than in United States. Use of Tractors and Motor Trucks Increasing

There are about 300 automobiles in the Puerto Cabello district of Venezuela, chiefly five-passenger cars of American manufacture, which retail at prices from 50 to 100 per cent. higher than in the United States. Consul F. A. Henry writes that while the use of motor trucks will probably increase in the future there are certain factors which tend to restrict the growth of this trade. Among these are the scarcity of skilled automobile mechanics, the enormous prices asked for gasoline, even though it is produced in the country, the poor quality of the roads, and the cheap cost and care of pack animals.

Consul George E. Chamberlin reports that about 50 tractors are in use in British Guiana, chiefly in the rice and sugar industries, and that there is no doubt the number will be greatly increased within a year or two. Owing to the soft character of the soil during the wet seasons the caterpillar type is very popular.

In Paraguay almost all residences are built of cheap brick which is manufactured locally, and then the façades are finished with a thick layer made of a mixture of lime and cement. For this purpose about 5000 bbl. of cement are imported annually.

On account of climatic conditions, due probably to the ocean trade winds, iron wire for screening of a quality such as is guaranteed in the United States for four years lasts but one year in Colombia. Copper-wire screening has been found very satisfactory, and a market may develop for this commodity there in time. The chief hindrance is the high duty of 20c. per gross kilo on copper goods.

The imports of wire nails into Argentina during 1917 amounted to 822,459 kilos; brass nails, 51,915 kilos; and cut nails, 1,136,819 kilos. Such articles have been furnished almost exclusively by the United States during the war period.

* * *

Germany's Disabled

In Germany an order has been issued requiring all public and private works, offices, and authorities to employ at least one severely disabled man for every 100 officials, employees, or workmen without distinction of sex. In agriculture 50 is substituted for 100. This order not only applies to the war disabled but to men disabled by accident.

Business Items

The Federal Tool Steel and Alloy Co. has moved its offices from Platt St. to the Woolworth Building, New York.

Edward J. Smith, 30 Church St., New York, announces that a new office has been established in the Mills Building, El Paso, Tex.

The Reliance Electric and Engineering Co. announces its removal from West St. to the Hudson Terminal Building, New York.

The E. B. Hayes Machinery Corp., Oshkosh, Wis., is planning to double the size of its plant and make a considerable increase in equipment.

The Chicago Pneumatic Tool Co. has moved its Milwaukee office from Room 1305, Majestic Bldg., to Room 1418 in the same building, where more convenient quarters have been obtained.

The Gale-Sawyer Co. has moved its manufacturing business from Boston to its new factory, South Weymouth. The general office and salesroom is located at 36 Oliver St., Boston, Mass.

The Booth-Hall Co., designers and builders of electric furnaces, has announced the removal of its executive and sales offices to Rooms 1007-1008 Hearst Building, 328 West Madison St., Chicago, Ill.

George G. Porter, one of the founders of the Porter-Cable Machine Co., Syracuse, N. Y., has opened an office in the New Keith Building, of the same city, as consulting mechanical engineer and factory organizer.

Briggs & Turivas, Inc., Westminster Building, Chicago, Ill., has opened a New York office at 1805 Equitable Trust Building. This office will be under the direction of Carl R. Briggs, president of the company.

The Liberty Systems Corporation of Edwardsville, Ill., has taken 13,000 ft. of floor space in the Overland Building, 2310 Locust St., St. Louis, Mo. It has been reorganized and has increased its capital to $1,500,000, and at present is employing 30 toolmakers and special mechanics.

Jeutter & Co. has established a factory at Charles City, Ia., for the purpose of manufacturing optical goods such as lenses for cameras and moving-picture machines. This is the only factory of its kind located west of the Mississippi River. P. A. Jeutter, M. Mickelson and A. Worth are members of the firm and are from South Bend, Ind.

The Van Dorn & Dutton Co., Cleveland, Ohio, manufacturer of gears, has opened branch offices at New York and Chicago. Harry F. Keegan, formerly with the Chicago surface lines, will manage the Chicago branch, with offices at 1241 First National Bank Building. His brother, John Keegan will manage the New York one, with offices at Room 317, 30 Church St.

Trade Currents

Cleveland Letter

While the week shows no marked improvement in machinery and machine-tool demand over that at the beginning of the month, there has been none of the slump prevalent in spots during the fore part of the year, and the situation locally seems to have settled down to a more stable basis. It is admitted in leading manufacturing and distributing establishments that while the actual demand is not as large as it was six months ago, yet inquiries are normal for this time of the year.

The most significant development of the last week or so is the increase here in inquiries and orders for higher grade equipment than was the case during the greater part of 1918. Manufacturing interests, according to one leading distributor, are now disposed to weed out the equipment of cheaper or inferior grade that they hastily stocked up with to meet the war-time need for speed, and now are installing better and more expensive equipment, making for more permanent character to their establishments. The main increase in the last week or so is in small equipment rather than large machines. Leading items still are milling machines, radial drilling machines, automatic screw machines and vertical boring mills.

About the largest order placed in this district this week was by the Ajax Manufacturing Co., for the production of forging equipment. Items called for have been a No. 3 horizontal boring mill, a 20-in. vertical slotting machine, a 42-in. lathe and several shaping machines.

Most of the small machines and tools are being absorbed by local and nearby automobile manufacturing interests and automobile-parts producers.

Chicago Letter

Continued good business is the cheerful story heard in most machinery dealers' offices. The surprisingly lively pace struck six weeks ago is keeping up. The announced decision of some of the great corporations to postpone the purchase of large lists until what appears to them to be a more favorable time has not had the depressing effect that might be expected, for the reason that purchases by small plants are making up the difference.

The factor most inclined to cast gloom over the situation is the recurring and spreading labor troubles, several large Chicago plants being affected as well as plants in Wisconsin and neighboring Illinois cities. It is understood that one Chicago corporaiton is transferring a large quantity of machine tools to a plant in another city to get away from strike troubles.

Inquiry and demand for medium and heavy machinery are excellent. Large lathes, boring mills, planing machines, etc., are sold with surprising frequency.

Factories using large quantities of machinery report the booking of many contracts, which is a good indication for the future.

Personals

CLARENCE T. WROE, assistant manager of the Alfred Herbert Co., New York, sailed for England, Apr. 28. Mr. Wroe will be gone several weeks.

W. F. ROCKWELL, vice president of Torbensen Axle Co., resigned May 1, to become general manager of the E. B. Hayes Machinery Corporation, Oshkosh, Wis.

E. K. THOMAS, formerly of the M. M. Granton Chemical Co., New Brunswick, N. J., has taken a position as superintendent with the Hunter Saw and Machine Co., Pittsburgh, Penn.

THOS. K. EGAN, for several years plant superintendent of the Reed-Prentice Co., resigned the first of the year to take a position with the D. E. Whiton Machine Co., New London, Conn.

A. C. LINDHOLM has resigned as mechanical engineer with the Colts Patent Fire Arms Manufacturing Co., Hartford, Conn., and is now general manager for the Franklin Machine and Tool Co., Springfield, Mass.

LIEUT.-COL. JOHN J. SWAN, formerly Personnel Branch, Operation Division, General Staff, after the armistice, Classification Division, Adjutant General's Office, resigned Apr. 7, to become associated with the Prest-O-Lite Co., Indianapolis, Ind.

JOHN F. NEVILLE, formerly with W. A. Tottle & Co. of Baltimore, Md., and Jas. McCafferty & Sons of Brooklyn, is now associated with the Hilo Varnish Corporation. Mr. Neville is well known to both the hardware and paint trade in this territory.

H. H. LOTZ, formerly with the Lowe Brothers Co., has become associated with the Hilo Varnish Corporation, Brooklyn, N. Y. Mr. Lotz will make his headquarters at Dayton and will look after both the manufacturing and the jobbing trade in southern Ohio.

MISS CELIA FERN HASKINS, St. Louis, Mo., will be the first woman to graduate from the electrical-engineering department of the University of Missouri. She will receive the degree of bachelor of science in electrical engineering at the June commencement.

FRANK J. TONE has been made president of the Carborundum Co., Niagara Falls, N. Y., succeeding the late Frank W. Haskell. GEORGE R. RAYNER has been made vice president, succeeding R. B. Mellon of Pittsburgh. F. H. MANLEY retains the office of treasurer.

J. A. TAGGART has severed his connection with the Advance Machinery Co., Van Wert, Ohio, after 20 years association and is now associated with A. L. Fader under the firm name of Fader & Taggart, 547 Washington Blvd., Chicago, Ill., doing business as direct factory representatives. The new firm is planning to handle several lines of wood-working equipment.